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# PHASE I

# Geology, Energy and Mineral (GEM) Resource Assessment of the Garnet GRA, Montana, including the Wales Creek (075-150 Hoodoo Mountain (075-151A) and Gallagher Creek (075-151B) Wilderness Study Areas

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# PHASE I

# Geology, Energy and Mineral (GEM) Resource Assessment of the Garnet GRA, Montana, including the Wales Creek (075-150), Hoodoo Mountain (075-151A) and Gallagher Creek (075-151B) Wilderness Study Areas

Bureau of Land Management
Contract Number YA-553-CT2-1039

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ANCHORAGE, ALASKA
JULY 1983

WGM INC.
MINING AND GEOLOGICAL CONSULTANTS

# EXECUTIVE SUMMARY

The Garnet Geology, Energy and Mineral Resource Area (GRA) encompasses the northern Garnet Range, near Drummond, Montana. The GRA is in the Missoula Resource Area of the Butte BLM district and includes three Wilderness Study Areas (WSAs): Wales Creek (075-150), Hoodoo Mountains (075-151A) and Gallagher Creek (075-151B).

The Garnet GRA is in the Montana Thrust Belt. Bedrock in the area consists of a thick series of Precambrian and Early Paleozoic sedimentary rocks which are folded and faulted. Plutons of igneous rocks intrude the older units. Young volcanic rocks, primarily lava, cover large parts of the area. The western part of the GRA includes several mining districts which produced gold, copper, silver, lead and zinc. Prospects and mineral occurrences are common and there are active gold placer operations in the southwest part of the area.

There are over 550 unpatented mining claims and 152 patented mining claims in the Garnet GRA. Forty of the unpatented claims are within or adjacent to the Wales Creek WSA. About 60% of the GRA, including 75% of the Wales Creek WSA, 95% of the Hoodoo Mountain WSA and 100% of the Gallagher Creek WSA, is covered by oil and gas leases or applications.

There are numerous geologic reports covering the area including studies by the Montana Bureau of Mines, the U.S. Geological Survey's CUSMAP program and the Department of Energy's NURE program. These reports include a substantial amount of geochemical data. Because of this large amount of data the

land classification resulting from the GEM resource assessment generally has a relatively high level of confidence. These classifications are summarized in the following table:

## SUMMARY OF GEM RESOURCES LAND CLASSIFICATION FOR THE GARNET GRA

| | Wales Creek<br>075-150 | Hoodoo Mountain<br>075-151A | Gallagher Creek<br>075-151B |
|---|---|---|---|
| Locatable Resources: | | | |
| a. Metallic Minerals | 4D/3C | 3C/2C | 2C |
| b. Uranium and Thorium | 2C | 2C | 2C |
| c. Non-Metallic Minerals | 3C (barite and limestone) | 2C | 1C |
| Leaseable Resources: | | | |
| a. Oil and Gas | 2C | 2C | 2C |
| b. Low Temperature Geothermal | 2B/3A | 1B | 1B |
| High Temperature Geothermal | 2B/3A | 1B | 1B |
| c. Sodium and Potassium | 2C | 2C | 2C |
| d. Other | 2C | 2C | 1C |
| Saleable Resources | 2C/3C (limestone) | 2C | 2C |

The Wales Creek WSA (075-150) has high to moderate potential for metallic mineral resources. This classification is strongly supported by abundant mineral occurrences and geochemical anomalies. Moderate geothermal potential may also exist, but the data base is insufficient for a reliable evaluation. Except for barite and limestone, the potential for other resources is considered low.

The Hoodoo Mountain WSA (075-151A) has moderate potential for metallic mineral resources in parts of the WSA and low potential in others. Much of the area is covered by lava deposits which makes a resource assessment difficult. Potential for other resources is considered low. The level of confidence level of the classification is moderate.

The Gallagher Creek WSA (075-151B) is almost entirely covered by lava and as such is considered to have a low favorability for most GEM resources. However, the confidence in the classification is only moderate.

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# GARNET GRA, MONTANA

## 1.0 INTRODUCTION

The Bureau of Land Management has adopted a two-phase procedure for the integration of geological, energy and minerals (GEM) resources data into the suitable/non-suitable decision-making process for Wilderness Study Area (WSAs). The objective of Phase I is the evaluation of existing data, both published and available unpublished data, for interpretation of the GEM resources potential of the WSAs. Wilderness Study Areas are grouped into areas based on geologic environment and mineral resources for initial evaluation. These areas are referred to as Geology, Energy, Mineral Resource Area (GRAs).

The delineation of the GRAs is based on three criteria: (1) a 1:250,000 scale map of each GRA shall be no greater than 8½ x 11 inches: (2) a GRA boundary will not cut across a Wilderness Study Area; and (3) the geologic environment and mineral occurrences. The data for each GRA is collected, compiled, and evaluated and a report prepared for each GRA. Each WSA in the GRA is then classified according to GEM resources favorability. The classification system and report format are specified by the BLM to maintain continuity between regions.

This report is prepared for the Bureau of Land Management under contract number YA-553-CT2-1039. The contract covers GEM Region 2; Northern Rocky Mountains (Fig. 1). The Region includes 50 BLM Wilderness Study Areas totalling 583,182 acres. The WSAs were grouped into 22 GRAs for purposes of the Phase I GEM resources evaluation.

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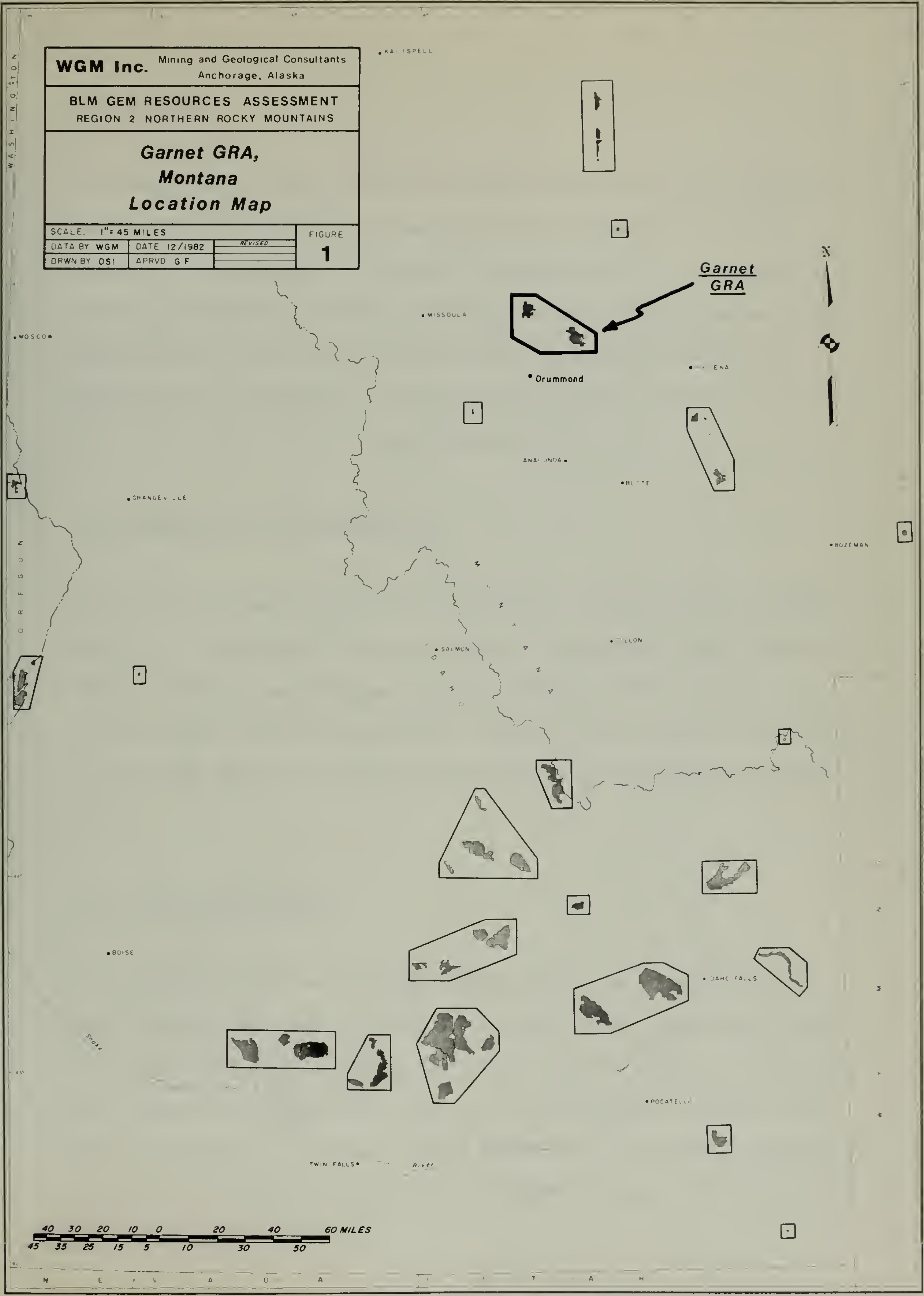
REGION 2 NORTHERN ROCKY MOUNTAINS

# Garnet GRA, Montana Location Map

| | | | |
|---|---|---|---|
| SCALE. 1"= 45 MILES | | | FIGURE 1 |
| DATA BY WGM | DATE 12/1982 | REVISED | |
| DRWN BY DSI | APRVD G F | | |



## 1.1 Location

The Garnet GRA is mostly located in Powell County but it does encompass a part of Missoula County to the west and Granite County to the south. It covers all or portions of Ts.11-14N., Rs.9-14W. (Fig. 2). The Garnet GRA covers approximately 470 square miles and contains three Wilderness Study Area (WSAs): Wales Creek (075-150), Hoodoo Mountains (075-151A) and Gallagher Creek (075-151B), a total of 27,217 acres. The area is in the Butte BLM district and the Garnet Resource Area.

## 1.2 Population and Infrastructure

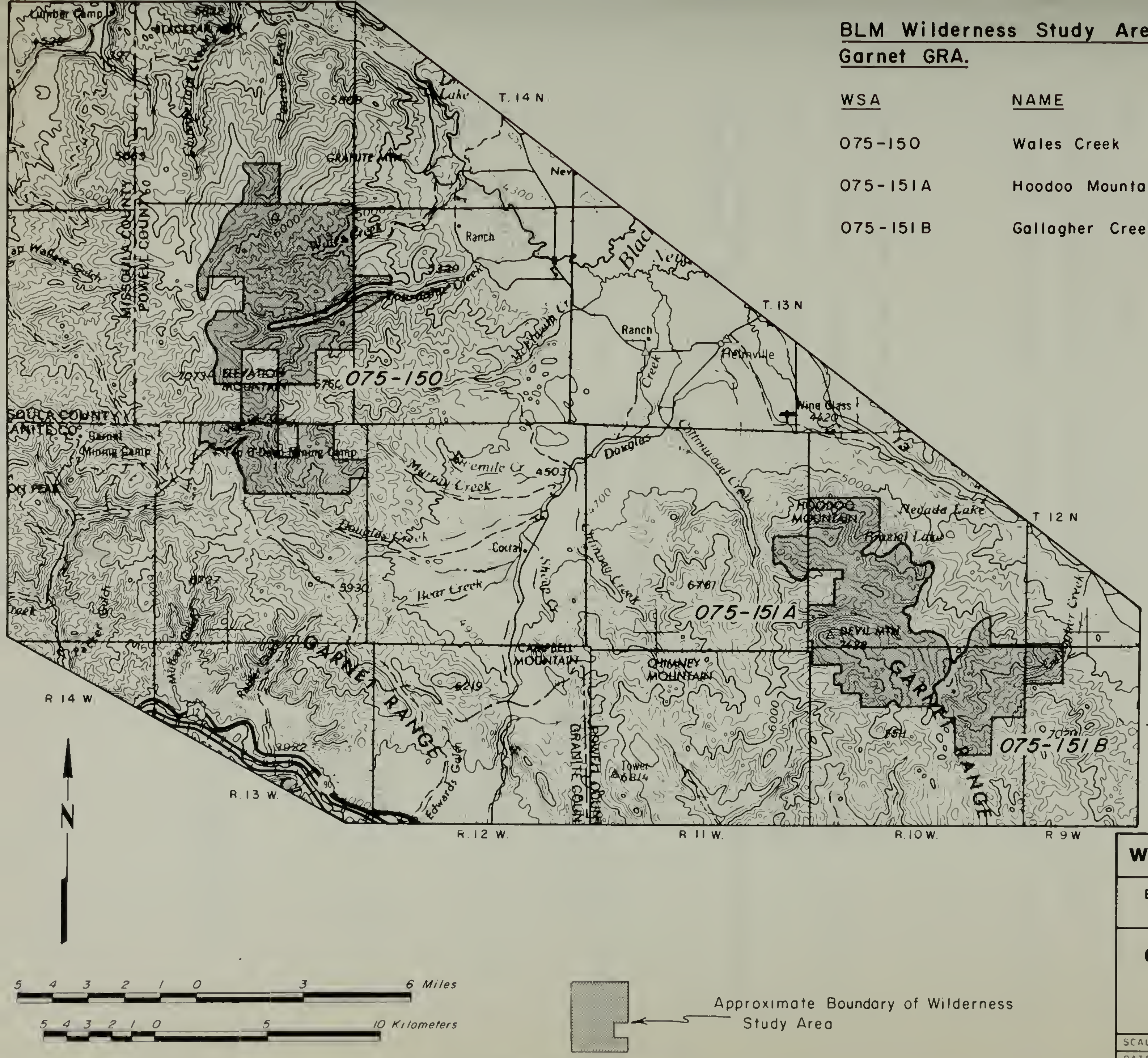
The town of Drummond (pop. 414) is located just south of the Garnet GRA (Fig. 1). Interstate 90 passes through the southwestern part of the area. Several improved State highways, gravel secondary roads, and jeep trails provide access within the Garnet GRA. Numerous gravel roads provide access to the areas around the WSAs and these are used by placer miners on Deep Creek.

## 1.3 Basis of the Report

This report is based on a review, compilation and analysis of available published and unpublished data on the geology, energy and mineral resources of the Garnet GRA. The western part of the area has a long mining history and consequently has been the subject of several geologic studies. The Butte quadrangle is covered by a NURE report and is currently being studied by the U.S. Geological Survey as part of CUSMAP program. Mining claim and

## BLM Wilderness Study Areas Included in the Garnet GRA.

| WSA | NAME | ACREAGE |
|---|---|---|
| 075-150 | Wales Creek | 11,580 |
| 075-151A | Hoodoo Mountain | 11,380 |
| 075-151B | Gallagher Creek | 4,257 |



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***Garnet GRA, Montana***

***Topographic Map***

| | | |
|---|---|---|
| SCALE 1"=4 MILES (1:250,000) | | FIGURE |
| DATA BY WGM | DATE 9/1982 | 2 |
| DRWN BY DSI | APRVD G F | |

oil and gas lease information were compiled from BLM land records. Aerial photographs and LANDSAT images of the GRA were also reviewed. In addition, a one-day field examination was made of the Wales Creek WSA in October 1982 by WGM geologists.

The data was compiled and reviewed by WGM project personnel and the panel of experts to produce the resource evaluation which follows. Personnel involved in the project and their general areas of responsibility are listed below:

| | |
|---|---|
| Greg Fernette, Senior Geologist, WGM Inc. | Project Manager |
| C.G. Bigelow, President, WGM Inc. | Chairman, Panel of Experts |
| Joel Stratman, Geologist, WGM Inc. | Project Geologist |
| Jami Fernette, Land and Environmental Coordinator, WGM Inc. | Claims and Lease Compilation |

## Panel of Experts

| | |
|---|---|
| C.G. Bigelow, President, WGM Inc. | Regional geology, metallic and minerals, mineral economics. |
| R.S. Fredericksen, Senior Geologist, WGM Inc. | Regional geology, metallic minerals. |
| David Blackwell, Ph.D., Professor of Geophysics, Southern Methodist University | Geothermal. |
| Jason Bressler, Senior Geologist, WGM Inc. | Regional geology, metallic minerals. |
| Gary Webster, Ph.D., Chairman, Department of Geology, Washington State University | Oil and gas. |
| William Jones, Senior Geologist, WGM Inc. | Metallic minerals, coal, industrial minerals. |

| | |
|---|---|
| J.F. McOuat, President, Watts, Griffis & McOuat Ltd. | Mineral economics, and industrial minerals. |
| E.F. Evoy, Senior Geologist, Watts, Griffis & McOuat Ltd. | Uranium and thorium. |

## 1.4 Acknowledgements

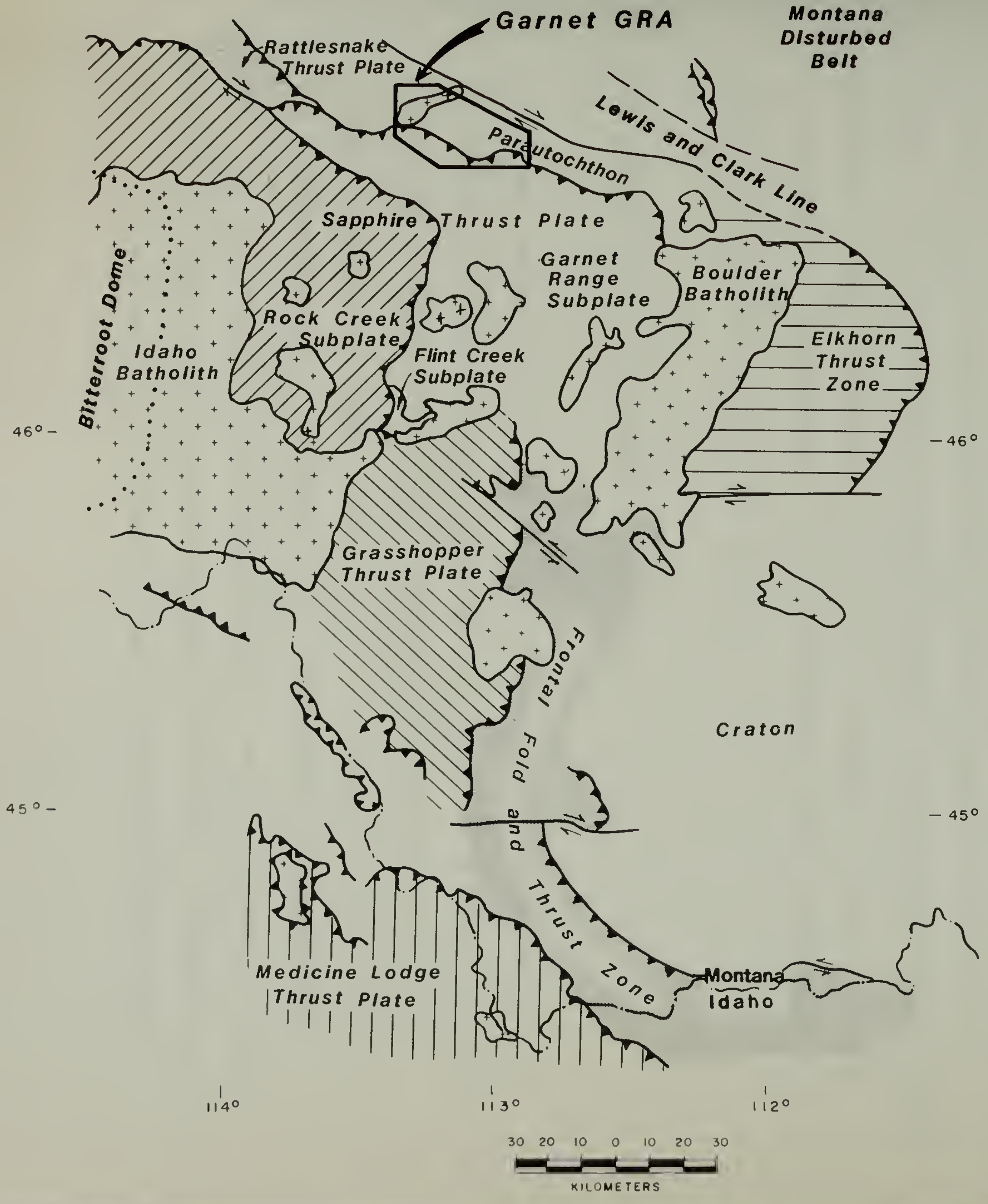
We would like to acknowledge the assistance of a number of individuals who aided in the completion of this report. Dave Williams, BLM-Butte district geologist, contributed useful discussion on the regional geology, and loaned WGM claim and mineral occurrence data. Jerry Klem, BLM-Billings, aided in the land review, helped search oil and gas well records and loaned WGM LANDSAT photos. In particular, we would like to thank Mindy Mason, BLM-Missoula, for her assistance in the compilation phase of the project. Dr. Syd Groff, Don Lawson, Henry McClernan and Richard Berg of the Montana Bureau of Mines and Geology gave freely of their knowledge of the area. Wes Campbell, U.S. Geological Survey, provided a pre-publication copy of geochemical data from the Garnet GRA. Chet Wallace generously provided unpublished information pertaining to the geology of GRA.

## 2.0 GEOLOGY

### 2.1 Introduction

The Garnet GRA is located in the western Garnet Range (Fig. 2). The western and southern portion of the GRA is underlain by folded and thrust faulted sedimentary rocks of Precambrian (older than 600 m.y.) to Cretaceous (141-65 m.y.) age. The Garnet granodiorite stock and associated satellite plugs and dikes intrude the sedimentary rocks. The eastern half of the GRA is covered by extensive andesitic volcanic rocks. The GRA straddles the leading edge of Sapphire thrust plate within the Montana Thrust Belt (Fig. 3).

A number of geologic reports describe the Garnet GRA. Detailed geologic reports covering portions of the GRA include Pardee (1918), Gwinn (1961) and Kauffman, (1963). The bedrock geology of the entire GRA has been recently mapped at reconnaissance scale (1:250,000) by the U.S. Geological Survey (Wallace, et al., 1977; 1978; 1981). The results of much of the recent work have not been published (C.A. Wallace pers. comm., 1982; Appendix II) but a summary is given by Ruppel et al. (1981). The surficial geology of most of the GRA has been mapped by Weber and Witkund (1979a, b, c). No detailed geologic investigations have been conducted in the three WSAs. The descriptions that follow are taken largely from Gwinn (1961), Kauffman (1963), Wallace et al. (1981) and Ruppel et al. (1981).



L E G E N D

- ▨ Grasshopper Thrust Plate
- ☐ Rattlesnake Thrust Plate
- ▥ Medicine Lodge Thrust Plate
- ☐ Frontal Fold and Thrust Plate

Saphire Thrust Plate

- ▨ Rock Creek Subplate
- ☐ Garnet Range Subplate
- ☐ Flint Creek Subplate
- ▤ Elkhorn Thrust Zone
- ☐ Intrusive Rocks
- Thrust Fault or Zone, Sawteeth on upper plate
- Fault

Map adapted from Ruppel, et.al. (1981)

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**Garnet GRA, Montana**

**Regional Geologic Setting**

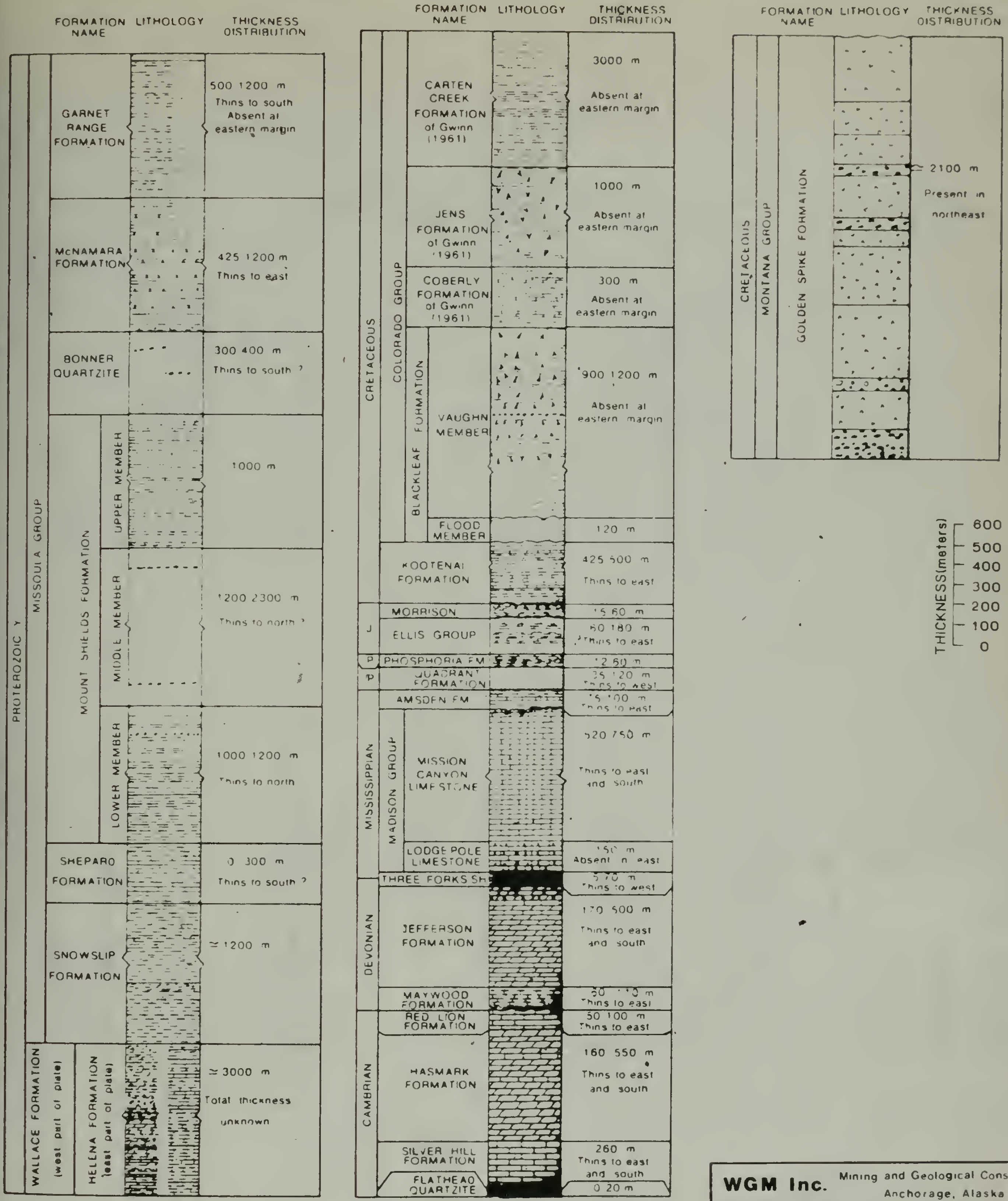
| | | | |
|---|---|---|---|
| SCALE AS SHOWN | | | FIGURE |
| DATA BY | DATE 12/1982 | REVISED | 3 |
| DRWN BY DSI | APRVD G.F | | |

## 2.2 Physiography

The Garnet GRA is in the Northern Rocky Mountains physiographic province (Hunt, 1974). The mountainous Garnet Range is the dominant topographic feature in the area (Fig. 2). The broad Douglas Creek drainage basin forms a large embayment within the range dividing the GRA along a northeast axis. The western part of the GRA has rugged terrain with an average relief of approximately 2,000 feet. The highest point is Elevation Mountain at 7,073 feet, and the lowest point is in the Clark Fork Valley with an elevation of 3,900 feet. The eastern part of the GRA consists of rugged terrain with a maximum elevation of 7,511 feet. The area is characterized by early-mature topography with steep-walled valleys, rolling uplands and well-drained slopes. The massive limestones of the Jefferson and Madison Formations form resistant ridges. The Mesozoic (230-65 m.y.) shales, siltstones and limestones form the lowlands and valleys. Precambrian strata and igneous rocks underlie the higher portions of the area.

## 2.3 Description of Rock Units

The oldest rocks in the Garnet GRA belong to the Belt Supergroup of Precambrian Y (1,600-800 m.y.) age (Fig. 4). These rocks comprise the six formations of the Missoula Group: the Snowslip, Shepard, Mt. Shields, Bonner McNamara, and Garnet Range Formations. They are exposed primarily in the northwestern part of the GRA (Fig. 5), including the Hoodoo Mountain WSA. The Belt rocks are predominantly clastic rocks consisting of reddish-brown argillites, siltites and fine-grained quartzites. The age of the Belt rocks as determined by potassium-argon and rubidium-strontium methods is



*Data by: Rupple, et.al., (1981).*

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## *Garnet GRA, Montana*

### *Stratigraphic Column*
### *of the*
### *Sapphire Thrust Plate*

SCALE **AS SHOWN**
DATA BY
DATE 9/1982
REVISED
DRWN. BY D.S.I.
APPRD G.F.
FIGURE
4

# Garnet GRA, Montana
## Explanation for Figure 5

### SEDIMENTARY

| Era | Symbol | Description |
|---|---|---|
| CENOZOIC | Q | Surficial deposits |
| | T | Surficial deposits |
| MESOZOIC | Kc | Coberly Formation |
| | Kbv | Blackleaf Formation (Kbv) |
| | Kbvv | Kbvv Vaugn member |
| | Kbvl | Kbvu upper part<br>Kbvl lower part |
| | Kbf | Kbf Flood member |
| | KK | Kootenai Formation |
| | Ju | Morrison, Sawtooth, Rierdon, and Swift Formations |
| PALEOZOIC | Pu | Shedhorn Sandstone, Phosphoria, Park City, and Quadrant Formations |
| | Pa | Amsden Formation |
| | Mm | Madison Formation |
| | Dj | Jefferson Formation |
| | Dm | Maywood Formation |
| | Crl | Red Lion Formation |
| | Ch | Hasmark Formation |
| | Csh | Silver Hill Formation |
| PRECAMBRIAN | Ygr | Garnet Range Formation |
| | Ym | McNamara Formation |
| | Ybo | Bonner Formation |
| | Yms (3, 2, 1) | Mount Shields Formation |
| | Ysh | Shepard Formation |
| | Ysn | Snowslip Formation |

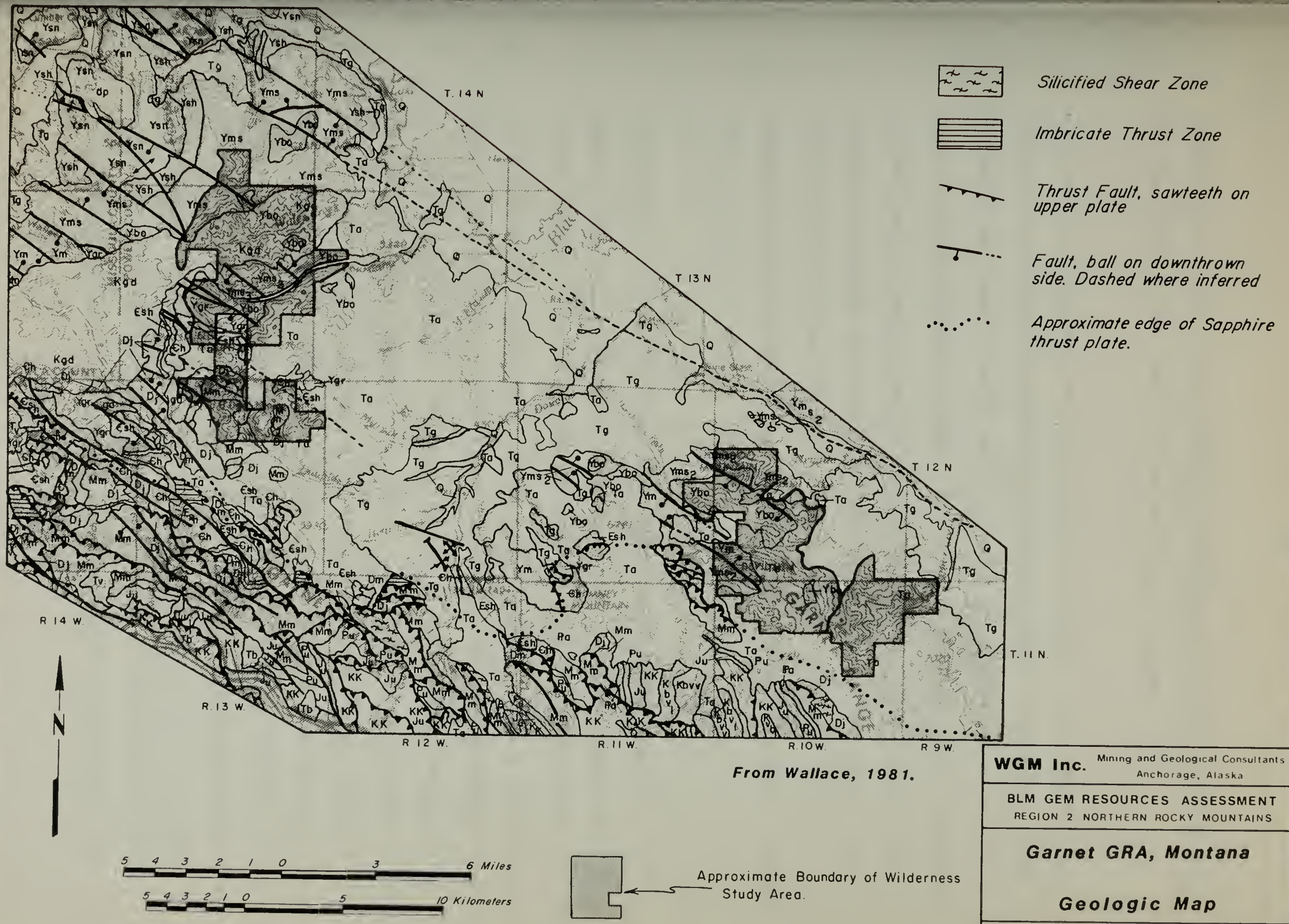
### IGNEOUS

| Symbol | Description | Period |
|---|---|---|
| | | Quaternary |
| Tv | Lavas, Tuff, Breccia, Hypabyssal rocks | Tertiary |
| Tb | Tb Basalt plugs, dikes, Lava flows, breccias | |
| Ta | Ta Andesite plugs, dikes, flows, breccias | |
| Kgd | Granodiorite stocks and dikes | Cretaceous |
| | | Jurassic |
| | | Permian and Pennsylvanian |
| | | Mississippian |
| | | Devonian |

### IGNEOUS ROCKS OF UNKNOWN AGE

| Symbol | Description | Period |
|---|---|---|
| dp | Diorite porphyry sills and dikes | Cambrian |
| gd | Granodiorite stocks and dikes | |
| | | Precambrian |

*Data by: Wallace, el. al., (1981)*


Silicified Shear Zone
Imbricate Thrust Zone
Thrust Fault, sawteeth on upper plate
Fault, ball on downthrown side. Dashed where inferred
Approximate edge of Sapphire thrust plate.
T. 14 N
T 13 N
T 12 N
T. 11 N.
R 14 W.
R. 13 W.
R 12 W.
R. 11 W.
R. 10 W.
R 9 W.
N
5 4 3 2 1 0 3 6 Miles
5 4 3 2 1 0 5 10 Kilometers
Approximate Boundary of Wilderness Study Area.
Ysn
Ysh
Yms
Ybo
Ymsg
Ym
Ygr
Kgd
Tg
Ta
Q
Esh
Ch
Dj
Dm
Mm
Pu
Pa
Ju
KK
Kbvv
Tb
Tv
dp

From Wallace, 1981.

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**Garnet GRA, Montana**

**Geologic Map**

| | | |
|---|---|---|
| SCALE 1"= 4 MILES | | FIGURE |
| DATA BY | DATE 1/1983 | 5 |
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1,100 m.y. for those rocks underlying the McNamara Formation and 930 m.y. for the Garnet Range Formation (Obradovich and Peterman, 1968).

The Snowslip Formation, the oldest rock unit exposed in the Garnet GRA, consists of alternating sequences of green and reddish quartzites, local carbonate beds some of which are oolitic and stromatolitic, and grayish green argillite (Childers, 1963). The green to greenish-gray colored units of the Snowslip locally contain minor disseminations of pyrite and copper minerals throughout the eastern part of the Belt Basin (Harrison, 1972). Total thickness of the Snowslip is on the order of 3,600 feet in the Scapegoat Wilderness to the north (Mudge and Earhart, 1978), but is unknown within the GRA.

The Shepard Formation conformably overlies the Snowslip Formation. The Shepard dramatically thickens from east to west. At its type section in Glacier National Park it is about 1,555 feet thick (Childers, 1963), and in the Scapegoat Wilderness north of the Garnet GRA it attains a thickness of 2,350 feet (Mudge et al., 1977). The Shepard is mostly thin-bedded micaceous siltite and dolomitic siltite with some silty limestone and argillite (Mudge and Earhart, 1978). In contrast to the reddish-brown strata of the underlying Mt. Shields Formation and the red and green color strata of the overlying Snowslip Formation, the rocks of the Shepard area are characteristically colored grayish-yellow. East of the GRA, Mudge (1972a) reports widespread glauconite along with abundant sedimentary structures including ripple marks, cross laminations, load casts and mud creeks in sandstone units belonging to the upper part of the Shepard. The contact with the overlying Mt. Shields Formation is gradational with a transitional zone

ranging from 50 to 100 feet in thickness (Mudge, 1972a; Mudge et al., 1974; Sommers, 1966).

The Mt. Shields Formation ranges from 2,700 to 7,150 feet in thickness and consists of reddish-brown thinly laminated micaceous siltite, argillite, and thin- to thick-bedded quartite. The Mt. Shields underlies a large area in the northwest corner of the Garnet GRA, including portions of the Wales Creek WSA. Small areas of the Hoodoo Mountain WSA are also underlain by the Mt. Shields. Quartzite is most common in the lower and middle parts of the formation and the fine-grained clastics, while present in the lower and middle parts, are most abundant in the upper part of the formation (Mudge and Earhart, 1978). The quartzites commonly display cross-laminations, ripple marks and mud crack structures. To the east, glauconite is common in the lower parts of the formation. Silt-crystal casts are widespread in the upper Mt. Shields and the formation locally contains thin quartz and barite veinlets (Mudge and Earhart, 1978).

The Bonner Quartzite, a distinctive ridge-forming unit, conformably overlies the Mt. Shields. The Bonner attains a thickness of 1,900 feet in the Scapegoat Wilderness, north of the Garnet GRA (Mudge et al., 1974) and 2,600 feet in the Bearmouth area (Kauffman, 1963). This unit consists one to three foot thick beds of pink and pale-red quartzite. Cross laminations and ripple marks are locally common (Mudge and Earthart, 1978). The Bonner Quartzite crops out in the Wales Creek and Hoodoo Mountain WSAs (Clapp and Deiss, 1931; Kauffman, 1963; Mudge et al., 1974).

The McNamara Formation consists of 2,100 to 3,100 feet of interbedded quartzite and micaceous and sandy argillite. The unit is divisable into three members: a basal micaceous argillite, a middle quartzite with local cross bedding and ripple marks, and an upper light green and red, fine-grained mud-cracked and ripple-marked argillite which becomes increasingly quartzitic towards the top.

The Garnet Range Formation which gradationally overlies the McNamara comprises a minimum of 3,000 feet of quartzite and brown to green and black argillite (Kauffman, 1963). A distinctive bed of coarse-grained pink, cross-bedded quartzite about 300 feet thick divides the formation into an upper and lower part. In the upper part of the formation, between 1,000 and 1,800 feet below the top, several lenticular bodies of calcareous quartzite (Kauffman, 1963) or oolitic limestone (Clapp and Deiss, 1931) occur. Massive barite veins are reported to occur in the Garnet Range in the western part of the Garnet GRA (Berg, 1982).

Cambrian (600-500 m.y.) rocks within the Garnet GRA are approximately 3,100 feet thick, comprising the Flathead, Silver Hill, Hasmark and Red Lion Formations (Fig. 4). The Flathead is a quartzite while the others are carbonates with minor amounts of intercalated argillaceous and siliceous rocks.

The Flathead Formation extends over much of Montana and northern Wyoming, and varies from a friable sandstone to indurated quartzite. In the Garnet GRA it is a medium- to coarse-grained brown, white, or pink to red quartzite containing traces of glauconite. Locally conglomeratic facies are present. The base of the Flathead has a slight angular discordance with the

underlying Garnet Range Formation. Regionally the Flathead ranges from 0 to 300 feet in thickness, but within the GRA it is 100 to 150 feet thick. The Flathead crops out in the Wales Creek WSA (Fig. 5).

The Silver Hill Formation gradationally overlies the Flathead Formation or forms an angular unconformity with the Garnet Range Formation in areas where the Flathead is missing. The Silver Hill is approximately 350 feet thick and is dominately laminated limestone overlain and underlain by thin gray-green shale units (Emmons and Calkins, 1913). The basal shale is 20 to 30 feet thick and contains a diverse trilobite fauna belonging to the Albertella zone which is dated as early Middle Cambrian (542-515 m.y.). The limestone consists of ridge-forming light gray limestone with minor interbedded argillaceous, cherty, or dolomitic layers. Algal-like structures have been found in the upper part of the limestone. Thickness of the limestone unit is appproximately 300 feet. The upper green shale member which is 20 feet thick and gradationally overlies the limestone member, has yielded a Middle Cambrian brachiopod fauna (Kauffman, 1963). Skarns are commonly developed where the Silver Hill limestones are in contact with the Garnet pluton (Wallace pers. comm., 1982). The Silver Hill Formation crops out in the Wales Creek WSA (Fig. 5).

The Hasmark Formation conformably overlies the Silver Hill Formation. The Hasmark is a dolomite sequence with a thickness in the Garnet GRA of approximately 1,200 feet which markedly increases to the west. The Hasmark is a white to light gray medium-crystalline dolomite that becomes arenaceous in the upper portion of the unit. At several locations the dolomite contains a black, sooty manganese matrix which in places is commercial-grade

manganese ore (Kauffman, 1963). Where highly fractured or adjacent to faulted or mineralized zones the Hasmark displays a creamy-yellow color. Locally the dolomite is silicified and chalcedonic veins and cavity fillings are present. The Hasmark Formation is Middle to Upper Cambrian (515-500 m.y.) in age based on stratigraphic position. The Hasmark crops out in the Wales Creek WSA (Fig. 5).

The Red Lion Formation overlies the Hasmark Formation and attains a thickness of 350 feet. The Red Lion is divisable into two members, the basal Dry Creek Shale and an argillaceous laminated limestone, the Sage Member. The Dry Creek Shale Member is 30 feet thick and consists of red and yellow shale, calcareous siltstone and dolomite. The red shale facies has abundant worm burrow trace fossils. The Sage Member comprises 330 feet of light gray limestone with finely interlaminated yellow-red argillaceous and siliceous material which imparts a reddish hue to the rocks. Locally, the argillaceous components predominate. Intraformational conglomerate and fossil "hash" beds are found at several horizons. The unit crops out in the Wales Creek WSA (Fig. 5).

The Devonian (395-345 m.y.) Maywood Formation (Fig. 4) forms a regional unconformity throughout western Montana with the underlying Cambrian section (Mudge, 1972a; Meyers, 1980). In the Garnet-Bearmouth area, the Maywood Formation consists of 306 feet of interbedded, gray to yellow-gray dolomite, laminated to cross-bedded dolomitic sandstone and thin gray limestone (Kauffman, 1963; Gwinn, 1961). The upper half of the unit is predominantly dark-gray limestone with subordinate dolomite and dolomitic siltstone. The upper contact of the unit is arbitrarily placed at the top of the last

yellowish siltstone. The Maywood is correlated with the "basal Devonian unit" of central Montana (Sloss and Laird, 1947), the Souris River Formation of the Williston Basin area, and the Beaver Hill Lake Formation of the Alberta Basin (Wilson, 1955). The Maywood represents a tidal facies deposited on a broad north-south trending cratonic shelf by westward advancing transgressive seas (Meyers, 1980).

The Maywood is gradationally overlain by the Jefferson Formation (Fig. 4) which consists of approximately 1,700 feet of dark colored limestone in the Garnet GRA. Elsewhere in southwestern Montana it averages 300 feet thick (Sloss and Moritz, 1951) and equivalent rocks in northwestern Montana average 1,000 feet in thickness. In the GRA, where the unit is discontinuously exposed, a tripartite subdivision of the Jefferson Formation is evident (Kauffman, 1963). The lower member consists of 600 feet of dark gray, fetid, finely crystalline limestone and dolomite with common stromatoporoidal structures. The middle member is 300 feet thick and consists of dark gray to black, saccharoidal dolomite which displays a strong petroliferous odor due to the presence of intergranular hydrocarbon material. The upper member comprises 800 feet of light to dark gray and gray-brown limestone. The limestone is thick-bedded to massive and conspicuously brecciated. Sloss and Laird (1947) have proposed that the brecciation at the top of the Jefferson Formation is a solution collapse feature induced by the phreatic weathering of anyhdrite units within the section. This hypothesis is supported by drill hole intercepts from the Jefferson in central and north-central Montana which contain significant amounts of anhydrite. Copper-bearing skarns are developed where the unit is in contact with the Garnet stock and associated intrusions. The Jefferson

Formation contains locally abundant but poorly preserved brachiopod fossils as well as stromatoporoids, gastropods, corals, and bryozoans.

Mississippian (345-310 m.y.) rocks, consisting of the Madison Group and the basal part of the Amsden Formation (Fig. 4), conformably overlie the Jefferson Formation (Smith and Gilmour, 1979). The Madison Group, a series of cliff forming limestones, is approximately 1,635 feet thick in the Garnet-Bearmouth area (Kauffman, 1963). The Madison is divisable into the lower thin-bedded Lodgepole Formation and the upper, more massive Mission Canyon Formation. These rocks were deposited on a shelf margin and carbonate platform east of a north trending foreland basin flanked by mobile orogenic highlands to the west (Gutschick et al., 1980).

The Lodgepole Formation is a well-bedded, dark gray to black, coarsely crystalline limestone with thin intercalations of shaley limestone. Large crinoid columnals locally constitute the bulk of the rock. The unit is approximately 500 feet thick.

The Mission Canyon Formation is composed of thick-bedded, coarsely crystalline dark gray limestones which weather to a characteristic pitted texture. The Mission Canyon contains abundant fossil debris consisting of corals, brachiopods, and crinoid stems. The formation generally forms cliffs, towers and spires. The Mission Canyon is correlative with the Castle Reef Dolomite (Smith and Gilmour, 1979) which is a reservoir for natural gas in other parts of the "overthrust belt" (Mudge et al., 1980). Locally, it is suitable for use as a high calcium limestone and has been quarried near Rattler Gulch in the Garnet GRA.

North of Tenmile Creek, along the ridge east of Sleepy Tom, a section of the Madison is conformably capped by red and red-stained gray to tan chert, approximately 150 feet thick, which may be lenticular in cross section. The chert is massive and brecciated. Locally, limestone beds and a few tan chert layers up to two inches thick interfinger with the chert breccia. The chert breccia is surrounded by a limestone matrix. Since the limestones underlying this chert unit appear to be abnormally thin, the chert breccia probably represents a reworking of the upper Mission Canyon Formation prior to deposition of the overlying Amsden Formation (Kauffman, 1963).

The contact between the Mission Canyon Formation and the Amsden Formation is marked by collapse sink-holes into which red clastics have slumped (Kauffman, 1963). The Amsden consists of reddish-brown calcareous siltstone and reddish shale with sparse interbeds of red-brown and gray dolomite and limestone. The top of the unit is marked by a 10-foot thick horizon of limestone pebble conglomerate and limestone concretions in a tan to red calcareous matrix. This marker bed is overlain by fine-grained tan calcareous sandstone which probably marks the base of the Quadrant Formation. Many geologists believe that the Amsden Formation bridges the Mississippian-Pennsylvanian (310-280 m.y.) time boundary (Perry and Sloss, 1943; Kauffman, 1963).

The Pennsylvanian Quadrant Formation (Fig. 4) which gradationally overlies the Amsden Formation consists of poorly bedded to massive, fine- to medium-grained, vitreous quartzites. The upper contact may be disconformable with the overlying Phosphoria Formation of Permian (280-230 m.y.) age in the Garnet GRA (Kauffman, 1963), although elsewhere in Montana the Quadrant-Phosphoria contact is gradational and conformable (Sloss and Moritz, 1951). The Quadrant is only 40 feet thick in the Garnet GRA (Kauffman, 1963) but thickens dramatically to as much as 2,600 feet in southwestern Montana and eastern Idaho (Scholten et al., 1955).

The Permian Phosphoria Formation (Fig. 4), missing in much of the Garnet GRA, unconformably overlies the Quadrant Formation. Where exposed, the Phosphoria consists of an upper chert, chert conglomerate, sandstone and volcanic detritus-bearing member; a medial phosphatic mudstone and oolitic phosphorite (the Retort Member); and a basal chert breccia member (Kauffman, 1963). Phosphate is mined from the Retort Member just east of the GRA. A convenient marker unit, the Shedhorn Quartzite Member, occurs near the top of the Phosphoria. The Shedhorn consists of fine- to medium-grained, white to tan and gray, quartzite resembling the Quadrant Formation. Although the Shedhorn is discontinuously present, it does appear to be lenticular. The Phosphoria is as much as 290 feet thick (Kauffman, 1963) and is exposed discontinuously along the flanks of the main fold present along the southern extreme of the GRA (Wallace et al., 1978).

The Ellis Group of Middle (176-158 m.y.) to Late Jurassic (158-141 m.y.) age unconformably overlies the Phosphoria Formation (Fig. 4). The unconformity at the base of the Jurassic is common throughout the western Montana

Thrust Belt although the time represented by the hiatus varies from place to place (Peterson, 1981). The Ellis Group is subdivided into the Sawtooth, Rierdon and Swift Formations.

In the Garnet GRA the Sawtooth Formation consists of a basal fine-grained sandstone, a medial dark gray shale with intercalated thin limestone and an upper calcareous siltstone (Kauffman, 1963). In its type locality the Sawtooth is 137 feet thick. The basal portion of the unit has yielded ammonite fossils and the upper member contains the pelecypod Gryphaea impressimarginata (Kauffman, 1963). The unit is confined to the southern portion of the GRA (Fig. 5).

The Rierdon Formation comprises 60 to 75 feet of limestone, gray calcareous shale and shaly limestone (Gwinn, 1961). The basal limestone unit, a ridge former, consists of dark brown oolitic to crystalline limestone. The upper part of this limestone which consists of dark brown to gray and black shaly limestone is fossiliferous and locally shows ripple marks on bedding surfaces.

The Swift Formation is a clastic unit which ranges from 115 to 245 feet in thickness (Imlay et al., 1948; Kauffman, 1963). The unit thickens to the east. It is divisable into a basal sandstone with intercalated conglomeratic siltstone and minor limestone beds, and an upper glauconitic sandstone unit. The basal sandstone contains abundant black chert fragments which impart a "salt and pepper" appearance to the rock. The limestone beds are fine-grained, light green to greenish-gray, and sparsely fossiliferous. The

glauconitic sandstone is diffentiated from the basal unit by its glauconite content, strong calcareous component, and lack of conglomeratic units.

The Late Jurassic Morrison Formation overlies the Swift with apparent conformity (Fig. 4). Thickness of the Morrison within the Garnet GRA ranges from 162 to 220 feet (Kauffman, 1963). The unit is composed of green or yellow fine-grained clastics including claystone, shale, siltstone and medium-grained sandstone. The lower part of the unit consists of calcareous siltstone; the middle part is gray or medium- to fine-grained salt and pepper sandstone; and the upper part is composed of siltstone, shale and mudstone. Except for wood fragments no fossils are found in the Morrison Formation in the GRA (Kauffman, 1963).

Cretaceous rocks unconformably overlie the Morrison Formation. These include the predominantly continental Kootenai Formation and the dominately marine Blackleaf Formation (Fig. 4). These units are exposed in the cores and flanks of large folds present at the southern margin of the Garnet GRA (Fig. 5).

Kauffman (1963) defines four mappable units in the Kootenai Formation: a basal clastic member, a lower calcareous member, an upper clastic member and an uppermost calcareous member. The basal clastic member is characterized by maroon and gray sandstone with intercalations of shale and siltstone and a basal chert cobble conglomerate (Gwinn, 1961; Kauffman, 1963). The succeeding lower calcalcareous member consists of 160 to 180 feet of dark gray to black fine-grained limestone with interbedded maroon to gray shale and siltstone (Kauffman, 1963) of lacustrine origin (Gwinn, 1961). The

overlying upper clastic member consists of green to maroon siltstone and shale with thin lithic sandstone and limestone beds. This member is 440 feet thick in the Bearmouth area (Kauffman, 1963). The uppermost calcareous member consists of 80 to 130 feet of fine- to medium-grained limestone with minor interbedded shale, siltstone and sand. The top of the member is marked by a widespread dark brown to gray coarse-grained limestone composed of gastropod shells (Reesidella montanaensis) of non-marine origin (Kauffman, 1963; Gwinn, 1961). Several other limestone beds are also present. These are separated by rose-colored calcareous shale and siltstone (Gwinn, 1961). The "gastropod limestone" has been quarried at Drummond, along the south border of the Garnet GRA (Chelini, 1965; McClernan, 1976).

Elsewhere in western Montana, as much as 3,000 feet of rocks correlated with the Colorado Group gradationally overlie the Kootenai Formation. In much of the area surrounding the Garnet GRA however, only the basal Flood Member of the Blackleaf Formation is present (Fig. 4). The remainder of the Colorado Group has been removed by erosion. The lower part of the Flood member consists of about 150 feet of marine black shale which represents the "transition beds" present elsewhere. In the area surrounding the GRA the upper part of the Flood consists of sandstones, siltstones, some thin limestones, dark gray to black fissile shale, and a few fine-grained sandstone partings. A prominent 5 foot thick ridge-forming fine-grained sandstone occurs about 150 feet above the base of the Blackleaf. This sandstone is a useful marker bed. Exposures of the Blackleaf are rare in the vicinity of the Garnet GRA (Kauffman, 1973; Cobban et al., 1959).

Tertiary (65-2 m.y.) sedimentary rocks cover a large portion of the Garnet GRA, largely in the Douglas Creek basin (Fig. 5) (Wallace et al., 1978). These sediments are dominately tuffaceous lake deposits which are locally carbonaceous and may contain large fragments of carbonized wood (Kauffman, 1963). Subordinate amounts of alluvial, fan and pediment gravel deposits occur in isolated bodies in the drainages of Douglas and Nevada Creeks north and west of the Hoodoo Mountain WSA (Wallace et al., 1978; Weber and Witkund, 1979a, b, c). Vertebrate and plant fossil assemblages in the Tertiary clastics indicate deposition in continental basins under an arid to semi-arid climatic regime (Miller, 1980; Thompson et al., 1981).

Pleistocene (2-0.1 m.y.) glacial till and gravel deposits occur in the Nevada Creek drainage (Fig. 5). Quaternary (2 m.y. to present) alluvial deposits occur in most drainages (Weber and Witkund, 1979a, b, c).

Tertiary volcanic rocks underlie much of the Garnet GRA including portions of the Wales Creek WSA and Hoodoo Mountain WSA and all of the Gallagher Creek WSA (Fig. 5) (McClernan 1976; Wallace et al., 1978). These volcanics include andesitic plugs, dikes, flows and volcanic breccias with subordinate basaltic dikes and flows as well as latite, rhyodacites and dacite flows and ash-flow tuffs (Wallace et al., 1978). Basaltic dikes and flows of Tertiary age crop out at the southern margin of the GRA in the Clark Fork Valley (Wallace et al., 1978). The basalts are dark red, purple, green and gray with olivine as an accessory mineral (Kauffman, 1963). Scattered intermediate to silicic lavas, ash, ash-flow tuffs and breccia crop out in the southwest corner of the GRA (Wallace et al., 1978). The rhyolitic volcanics

consist of light colored porphyry with quartz and orthroclase phenocrysts comprising 20% of the rock (Kauffman, 1963).

Plutonic rocks consisting of granodiorite, quartz monzonite and granite occur in the western part of the Garnet GRA. These rocks contain at least 10% modal or normative quartz (Kauffman, 1963) (Fig. 5). The Garnet stock and other smaller satellitic plugs underlie much of the northern Wales Creek WSA (Wallace et al., 1978, 1981). The Garnet stock which underlies approximately 25 square miles of the GRA, is composed of quartz, zoned plagioclase, orthoclase, hornblende, biotite, chlorite, apatite and magnetite, and ranges from quartz monzonite to granodiorite in composition. The plagioclase has been locally sericitized especially near the margin of the stock (Kauffman, 1963). The intrusive is well jointed and weathers to spheroidal boulders (Weber and Witkind, 1979b). C.A. Wallace (pers. comm., 1982) reports that the stock is largely homogeneous in the western portion, but that some monzogranite is present at the head of the Wales Creek possibly indicating differentiation of a multiple intrusion. A small plug of diorite porphyry occurs about three miles north of the Garnet stock within the Garnet GRA (Wallace et al., 1978, 1981) and may be a satellite of the main stock (Wallace pers. comm., 1982). Dikes of granodioritic composition which intrude the sedimentary country rocks are probably consanguinous with the Garnet stock (Kauffman, 1963; Wallace per. comm., 1982). Aplite dikes as much as three feet across (Kauffman, 1963) and pegmatite dikes (Pardee, 1918) locally cut the Garnet stock.

Metamorphic aureoles ranging from tens to thousands of feet in width surround the intrusives. In the case of the Garnet stock, the metamorphic

effects may extend more than a mile from the pluton (Kauffman, 1963). Skarns are commonly developed where calcareous units, particularly the Silver Hill and Jefferson Formations, are in contact with the stock (Pardee, 1918; Kauffman, 1963; Wallace pers. comm., 1982). Contact effects in pelitic rocks consist of hornfelsing with local development of cordierite (Pardee, 1918). Minor skarnification and hornfelsing is also associated with the granodiorite dikes (Kauffman, 1963).

## 2.4 Structural Geology and Tectonics

The Garnet GRA lies astride the leading edge of the Sapphire thrust plate and parautochonous terrane (Fig. 3). The Sapphire thrust plate is situated in the Montana Thrust Belt between the Bitterroot Dome of the Idaho batholith and the Boulder batholith. Just outside of and parallel to the northern boundary of the GRA is the Lewis and Clark line or Montana lineament which separates the southwestern Montana batholithic terrane from the Montana Disturbed Belt to the north (Weidman, 1965). The Sapphire thrust plate is clearly a tectonic unit due to the distinguishing physical characteristics and patterns of distribution of the thrust faults and folds within it. These characteristics and patterns include: (1) anastomosing imbricate thrust faults, the spacing of which is closely related to the types of rocks involved in faulting; (2) abundant younger-over-older thrusts, mixed steep and flat west-dipping thrusts and some east-dipping thrusts; (3) isoclinal folds that are overturned towards the east; and (4) the non-coherent breccia of sole zones of thrust faults. The Sapphire thrust plate can be further divided into three structural divisions; the

Rock Creek, the Garnet Range, and the Flint Creek subplates (Ruppel et al., 1981).

The Sapphire tectonic block consists of carbonates and clastics belonging to the Belt Supergroup, carbonate and minor clastic rocks of Paleozoic age, and an abnormal sequence of Mesozoic clastic rocks. The block appears to have formed the roof and upper part of the eastern half of the Idaho batholith at the time of magma emplacement. Thus, the lower part of the block probably consists of granite detached from the roof of the batholith. Small granitic plutons commonly penetrate the Sapphire block and its crumpled fringe. Eastward movement of the thrust plate appears to be 30 to 40 miles as indicated by: (1) the distance between the apparent center of the Sapphire block and that of the Bitterroot Dome and (2) the minimum values for movement based on rotation of earlier folds by simple shear in the detachment zone and for movement on thrust faults in the leading edge of the block is 10 and 15 miles respectively (Hyndman, 1978).

The portion of the Sapphire thrust plate underlying the Garnet GRA belongs to the Garnet Range subplate (Fig. 3). Structurally this subplate is characterized by: (1) imbricate, anastomising, listric thrust and reverse faults which are inclined to the south and southwest in the Garnet Range, and which form coherent breccia in carbonate rocks and noncoherent gouge in sandstone and shale; (2) disrupted and contorted shaly rocks which occur up to 300 feet from the thrust surfaces; (3) few flat faults; (4) tight isoclinal folding of upper Paleozoic and Mesozoic rocks; (5) thrust faults with small stratigraphic separation that occur on the flanks or along the axial traces of isoclinal folds; (6) tightly compressed dragfolds and

widespread shearing along thrust faults; and (7) bedding-plane thrusts in shaly beds of the Amsden Formation and in the Flood Member of the Blackleaf Formation. Along the north flank of the Garnet Range the leading edge of the subplate is formed by a complex of anastomosing imbricate thrust faults (Ruppel et al., 1981).

The relationship of the parautochthonous terrane to surrounding tectonic units is not well understood. The terrane is characterized by vertical faults and open folds. It may merge with the Elkhorn thrust zone to the southeast (Fig. 3) or it may be separated from the Elkhorn terrane by thrust faults having small apparent displacement. In any event, rocks belonging to the Missoula Group within the parautochthon are similar in sedimentary structures, lithofacies, and thickness to rocks from the Missoula Group in the Rattlesnake and Elkhorn terranes. This suggests a relatively small tectonic superposition of the original depositional basin.

The Montana lineament (or Lewis and Clark line), just north of the Garnet GRA, is a wide zone of strike-slip faulting which extends east of Helena and north of Townsend Valley (Reynolds, 1976). The structure is parallel to other northwest-trending features such as the Nye-Boulder lineament (Halbouty, 1976). It appears to control the distribution of Tertiary volcanic centers (Chadwick, 1981) and hydrothermal activity (Chadwick and Leonard, 1979).

## 2.5 Paleontology

A description of the fossils in the region surrounding the Garnet GRA is given by Gwinn (1960 and 1961) and Kauffman (1963). Although the Paleozoic and Mesozoic units locally contain abundant invertebrate fossils, no outstanding collection localities are reported in the GRA. However, Alt and Hyndman (1972) report that pelecypod and brachiopod fossils can be found in limestone exposed in the immediate Drummond area and in quarries in the Madison Formation. Leaf and insect fossils occur in Tertiary strata about eight miles north of Drummond.

Abundant invertebrate fossils including spirified brachiopods, crinoid columnals, bryozoans, straomatoporoids, corals, and trilobites (Kauffman, 1963) are likely to be found in areas of the Wales Creek WSA underlain by carbonate rocks of the Silver Hill, Jefferson and Madison Formations. It is unlikely that fossils occur in the Hoodoo Mountain and Gallagher Creek WSAs which are mainly underlain by Precambrian strata and Tertiary volcanic rocks.

## 2.6 Historical Geology

The Precambrian Belt Basin developed about 1,450 m.y. ago and was an active depositional basin for 600 m.y. (Harrison, 1972). This basin was a major northwest-trending trough which was the site of deltaic, shelf and basin sedimentation. Regionally the Wallace and Helena Formations which are not exposed in the Garnet GRA, comprise a shelf-slope sequence and a basin-axis facies with the source and shelf located to the west. Rocks belonging to

the Mt. Shields Formation, a thick northeasterly prograding delta sequence, indicate a period of renewed subsidence and deposition during later Precambrian time (Ruppel et al., 1981).

The Paleozoic rocks in the Garnet GRA are dominately shallow water, marine shelf carbonates which generally exhibit a three-stage transgressive-regressive sequence (Peterson, 1981). The sequence starts with transgressive Cambrian sandstone (Flathead Quartzite)-mudstone and limestone (Silver Hill Formation)-dolomite (Hasmark Formation)-deep water limestone. Regression is indicated by the Dry Creek Member of the Red Lion Formation which consists of shallow water dolomite and shale (Mudge, 1972a). Laminated argillaceous limestone belonging to the Sage Member of the Red Lion Formation indicates a transgressive depositional environment and marks the last stage of the sequence.

The lack of Ordovician (500-435 m.y.) Silurian (435-395 m.y.) strata in the area indicates a protracted period of emergence and erosion. This emergent period and earlier Cambrian uplifts reflect the development of the Sweetgrass Arch as a positive tectonic feature (Mudge, 1970).

During most of Devonian time the area encompassing the Garnet GRA was a partly emergent shallow marine shelf at the edge of the Sappington-Cottonwood Basin and Cordilleran miogeosyncline (Smith and Gilmour, 1979). Local restricted basins developed behind stromatoporoid-coral reefoid banks (Meyers, 1980). Extensive evaporites were deposited in the back-bank areas and westward refluxion of magnesium from dissolved evaporites led to extensive early formation of dolomites (Peterson, 1981). In very late

Devonian time, the initial incursion of the Madison sea from the Cordilleran miogeosyncline occurred resulting in the formation of the Big Snowy Trough across central Montana. This transgression is recorded in Lodgepole strata which was deposited over the existing irregular erosion surface in shallow basins. As the rapid transgression continued, downwarping of the Big Snowy Trough (or the rise in sea level) exceeded rates of sediment influx resulting in deeper water environments. Finally prior to deposition of the Mission Canyon Limestone regression of the Madison seas began. As exposure progressed the shelves became the sites of sabkhas and salt pans in which evaporites were deposited. The withdrawal of the Madison sea from most of the Montana craton exposed the Mission Canyon to subaerial weathering and subsequent karst formation as shown by the presence of collapse structures at the Mission Canyon-Amsden unconformity (Smith and Gilmour, 1979; Kauffman, 1963).

Subsequent transgression in Pennsylvanian time (Smith and Gilmore, 1979) resulted in deposition of clastic strata belonging to the Amsden and Quadrant Formations. The clastic debris had a source area to the west or northwest which continued to supply sediment to the basin through the Permian (Kauffman, 1963). The Permian section is a regressive sequence as indicated by the terrestrial Phosphoria Formation. This was followed by a period of pre-Middle Jurassic erosion (Peterson, 1981).

The Early Jurassic marks the beginning of a series of worldwide transgressive-regressive cycles which in North America involved the incursion of boreal seas onto the continent (Peterson, 1981). The Ellis Group records a period of complex gentle uplifts with deposition of clastic debris from a

western source area. These uplifts may in part reflect the initial development of the Idaho and Boulder batholiths. Within the Ellis Group the basal conglomerates of the Sawtooth Formation indicate a period of erosion of Mississippian carbonates to the west (Mudge, 1972a). These grade to finer, deeper water, clastic sediments in the Rierdon and lower Swift Formations. The upper Swift is coarser grained and has numerous fossil ripple marks, burrows, and rain drop impressions indicating renewed uplift and regression. Current directions in conglomerates in the upper Swift Formation indicate that the source was a positive area to the northwest (Mudge and Shepard, 1968). The Morrison Formation is comprised of terrestrial and fresh water clastics with some limestone and tuffaceous rocks which mark a major period of uplift in western Montana (Mudge, 1970).

Relatively gentle pulsating uplifts continued through the Cretaceous and into the Tertiary (Mudge, 1970; Gwinn, 1960). Truncation of the upper Morrison and basal conglomerates and channels in the Cretaceous Kootenai Formation indicate a period of erosion in pre-Kootenai time followed by deposition of lake sediments and shallow brackish water to marine sediments. The Colorado Group sediments give evidence for as many as five transgressive-regressive cycles. Ripple marks, cross bedding, mud cracks and fresh water fossils indicate that the Flood Member of the Blackleaf Formation was deposited in a regressive sea. In the area surrounding the Garnet GRA, the units belonging to the Colorado Group which overlie the Flood Member are generally absent due to erosion.

Radiometric and stratigraphic evidence indicate that the Sapphire thrust plate was emplaced during Late Cretaceous (100-65 m.y.) time. Granodiorite

belonging to the Garnet stock (in the Wales Creek WSA) which cuts thrust faults in the leading edge of the Sapphire block, yields radiometric ages of 82.4 ± 1.0 m.y. from hornblende and 79.1 ± 7 m.y. from biotite. The age of the hornblende represents a minimum age; therefore, thrust faulting appears to have ceased before 82 m.y. (Ruppel et al., 1981). The Sapphire thrust plate cut a large segment of the Idaho batholith which was probably in its latest stages of crystallization at the time since almost undeformed K-feldspar megacrysts cut across the shears of the detachment zone. A few potassium-argon and fission-track dates from the border zones indicate that the batholith was emplaced about 70 to 90 m.y. ago.

The origin of the smaller granitic bodies is not fully understood, but they appear to lie along essentially contemporaneous westward dipping faults (Hyndman et al., 1975). If the magmas were emplaced into the Sapphire block prior to or during movement of the block, their source would have probably been in the Idaho batholith magma-generation zone. However, most of the plutons have injected pre-existing thrust faults and are undeformed. Thus, the smaller plutons evidently intruded to their present level after the Sapphire block had ceased movement, and after solidification of much of the Idaho batholith (Hyndman, 1978). Thrusting was followed by block faulting which continued into the Quaternary (Mudge, 1970, 1972a).

The Tertiary volcanic rocks in the Garnet Range may be associated with the Montana lineament, also known as the Lewis and Clark line. This structure may mark a long lived zone of weakness which served as a magma conduit (Chadwick, 1981; Chadwick and Leonard, 1979) since movement on the zone extended at least into Oligocene (38-23 m.y.) time (Williams, 1975).

Emplacement of volcanic rocks of mafic to felsic composition was also controlled in part by the late high angle normal faults oriented parallel to transverse to the structural grain (Kauffman, 1963; Wallace et al., 1981; Chadwick, 1981). Outcrops of rhyolite and basalt near Bearmouth have been dated at 47 to 45 m.y. by Williams et al. (1976). Lipman et al. (1972) also report an Eocene (55-38 m.y.) age for andesites found in the Garnet Range. Alt et al. (1971) suggest that some of the volcanic rocks in the region may be as young as Pleistocene.

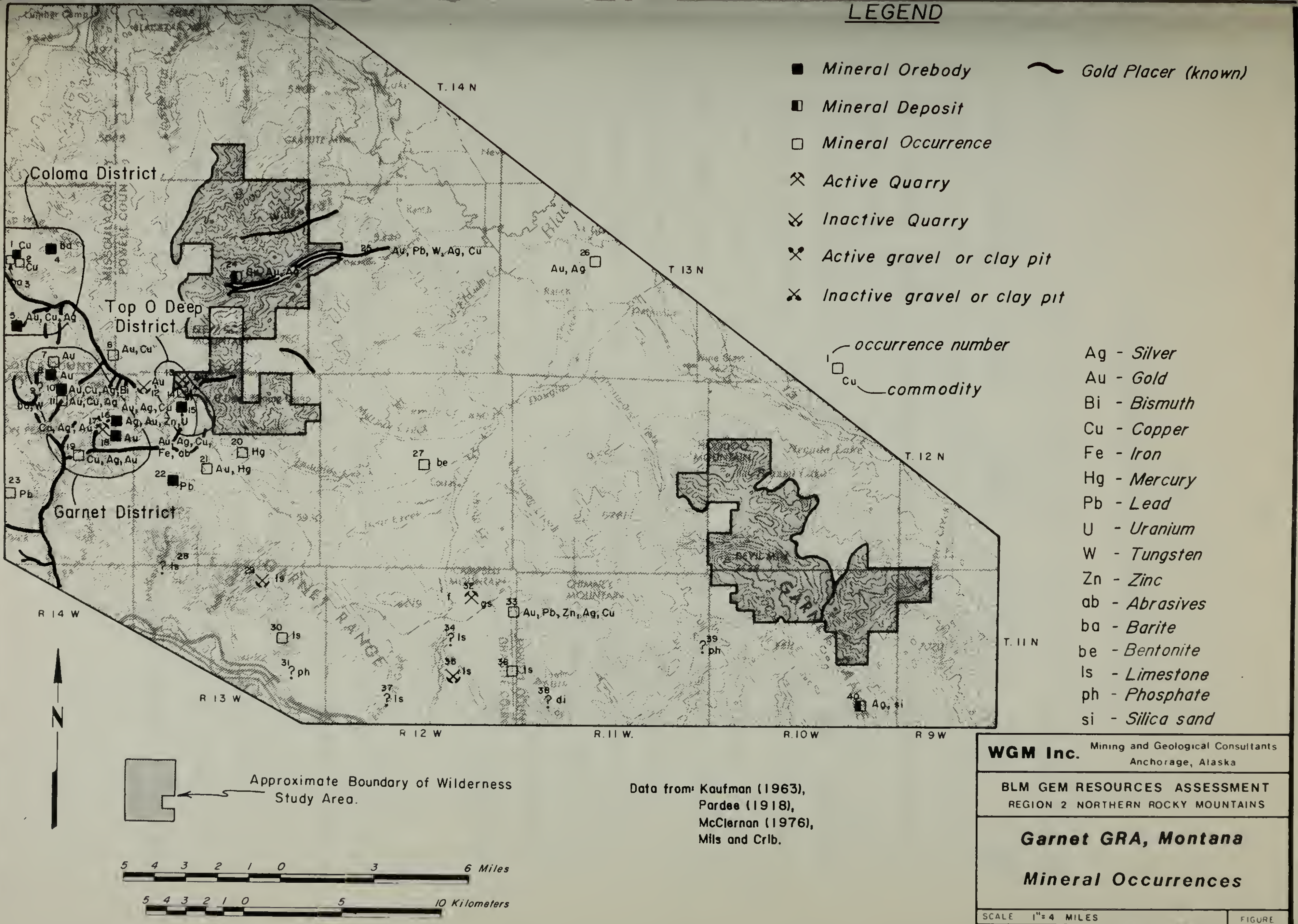
During the Pleistocene several advances and subsequent melting of large glaciers resulted in the formation of most of the surficial deposits in the Nevada Creek drainage (Weber and Witkund, 1979a, b, c).

## 3.0 ENERGY AND MINERAL RESOURCES

Data on the energy and mineral resources of the Garnet GRA was compiled from all available sources. The primary sources of data on mineral resources were compilations by Lange (1977), McClernan (1976), Bentley and Mowat (1967), Berg (1969, 1982), Chelini (1965), Salisbury and Dietz (1982), the U.S. Bureau of Mine's MILS file and the U.S. Geological Survey's CRIB file. Detailed descriptions of deposits and districts were obtained largely from reports by Pardee (1918), Kauffman (1963) and Gwinn (1961). Data on energy resources was obtained from Cole et al. (1982), Sonderegger and Bergantino (1981), Cavanaugh and Cavanaugh (1982a, b) and Williams (1975). Additional information was provided by C.A. Wallace (pers. comm., 1982; Appendix II).

### 3.1 Known Mineral and Energy Deposits

The Garnet GRA contains several areas with historical production (Fig. 6, Table I). These include the Garnet (First Chance), Coloma and Top O'Deep lode mining districts; an area near the head of Elk Creek; the Baker and Sullivan mine (loc. 22, Fig. 6); and the Bear Creek placer mining district. The Top O'Deep district is immediately adjacent to the southwestern boundary of the Wales Creek WSA (075-150). Table I summarizes metal production from the Garnet and Coloma districts:



Data from: Kaufman (1963),
Pardee (1918),
McClernan (1976),
Mils and Crlb.

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REGION 2 NORTHERN ROCKY MOUNTAINS

**Garnet GRA, Montana**

**Mineral Occurrences**

| SCALE 1" = 4 MILES | | FIGURE |
|---|---|---|
| DATA BY | DATE 1/1983 | 6 |
| DRWN BY DSI | APRVD G.F | |

## TABLE I

## METAL PRODUCTION FROM THE GARNET GRA

| District | Gold (oz) | Silver (oz) | Copper (lb) | Lead (lb) | Zinc (lb) |
|---|---|---|---|---|---|
| Garnet 1867-1960 | 113,139 | 101,962 | 166,699 | 7,442 | 1,744 |
| Coloma 1897-1916 | 17,456 | 21,950 | 13,503 | 18,856 | 800 |

Production from the Top O'Deep district was estimated at $50,000 prior to 1916 (Pardee, 1918). Shipments recorded in 1918, 1926, 1931 and 1953 are thought to have increased production figures by more than $5,000. Most of the production from the Top O'Deep district seems to have been from placer mining and was credited to the Bear Creek district. Pardee (1918) reports minor production (less than $50,000 total) from several mines at the head of Elk Creek (loc. 16, Fig. 6) including the Dandy, Haparanda, and Idaho. The Dandy apparently produced a considerable amount of ore subsequent to Pardee's report, but the production was credited to the Coloma district. The Baker and Sullivan mine is reported to have produced $11,000 worth of silver-lead ore (Pardee, 1918). Accurate records of placer gold production from the Bear Creek district do not exist but Kauffman (1963) estimates that at least $10,000,000 of gold was produced.

In the Garnet district about 20 individual mines have been productive since discovery of the district in 1867 (Table II). The most important producers were the Dewey, Nancy Hanks, Shamrock, Magone and Anderson and the Crescent-Lead King-Red Cloud Group mine (all loc. 10, Fig. 7). Production was continuous until 1952 except for the years 1929-1930. One ore shipment was recorded in 1955 and the Spokane mine (renamed the Jackie Marie) was under development in 1960 (Kauffman, 1963).

## TABLE II

## MINERAL OCCURRENCES AND DEPOSITS IN THE GARNET GRA, MONTANA

| Map No. | Name | Location | | | Commodity | Description | Reference |
|---|---|---|---|---|---|---|---|
| | | Sec. | T. | R. | | | |
| 1 | Elk Creek Barite | 16 | 13N | 14W | Barite | Surface op, unknown | MILS |
| 2 | Morse and Kennedy | 12 | 13N | 14W | Copper | u/g op, unknown | MILS |
| 3 | Unameded Barite | | | | | | |
| 4 | Greenough | 15 | 13N | 14W | Barite | u/g op, unknown | MILS |
| 5 | Rambler Mine | 28 | 13N | 14W | Copper, gold, silver | u/g caved, unknown | MILS |
| 6 | Sierra Mine | 35 | 13N | 14W | Copper, silver | 280' u/g, caved; qtz-tet veins - small prod. reported | Pardee, 1918 |
| 7 | Cascade Mine | 3 | 12N | 14W | Gold | u/g op, caved; qtz-tet veins in grndte. $6,000 prod. in 1916 | Pardee, 1918 |
| 8 | Spokane Mine | 4 | 12N | 14W | Gold, copper | u/g op, caved | Pardee, 1918 |
| 9 | | | | | | | |
| 10 | Dewey Mine | 3 | 12N | 14W | Gold, silver, copper | u/g op, caved; 4,500 oz Au prod. qtz-barite-sulfide veins in grndte. | Pardee, 1918 |
| 10 | Fairview Mine | 11 | 12N | 14W | Gold, silver, bismuth | qtz vein u/tellurides ave. 0.77 oz Ag/t, 1.1 oz Au/t | Pardee, 1918 |
| 10 | Garnet | 3 | 12N | 14W | Barite | Unknown | MILS |
| 10 | Grant and Hartford | 3 | 12N | 14W | Gold | u/g op, caved; qtz-gold vein 1,000 oz Au prod. in 1916; ave. 1.5 to 5 oz Au | Pardee, 1918 |
| 10 | Idaho Mine | 12 | 12N | 14W | Gold | u/g op, caved; prod. 480 oz Au from qtz veins | Pardee, 1918 |
| 10 | International | 3 | 12N | 14W | Gold, copper, silver | u/g op, caved; 435 oz Au prod. 1910-1914 | Pardee, 1918 |

## TABLE II (Cont.)

## MINERAL OCCURRENCES AND DEPOSITS IN THE GARNET GRA, MONTANA

| Map No. | Name | Location Sec. | T. | R. | Commodity | Description | Reference |
|---|---|---|---|---|---|---|---|
| 10 | Lead King | 3 | 12N | 14W | Gold | u/g op, caved; qtz-barite-sulfide veins produced approx. 16,400 oz Au | Pardee, 1918 |
| 10 | Lowery Mine | 3 | 12N | 14W | Gold | Unknown | Pardee, 1918 |
| 10 | Magone and Anderson | 3 | 12N | 14W | Gold | u/g op, caved; produced $300,000 | Pardee, 1918 |
| 10 | Mountain View | 2 | 12N | 14W | Gold | Unknown | Pardee, 1918 |
| 10 | Munsungbrod | 10 | 12N | 14W | Gold | u/g op; unknown | MILS |
| 10 | Nancy Hanks | 3 | 12N | 14W | Gold | u/g op, caved; qtz-sulfide vein, $300,000 produced 1916, ave.<br>4 oz Au/t<br>10 oz Ag/t | Pardee, 1918 |
| 10 | Red Cloud Mine | 3 | 12N | 14W | Gold | qtz-sulfide vein in quartzite; ave. 1 oz Ag/t, 1.5 oz Ag/t | Pardee, 1918 |
| 10 | Shamrock Mine | 3 | 12N | 14W | Gold, copper | u/g op, caved; $100,000 production reported in 1916 | Pardee, 1918 |
| 10 | Sierra Mine | 3 | 12N | 14W | Gold, copper, silver | u/g op, caved | Pardee, 1918 |
| 10 | Tiger Mine | 3 | 12N | 14W | Gold, silver | u/g op, caved; $23,000 production | Pardee, 1918 |
| 12 | Elk Creek Placer | 6 | 12N | 13W | Gold | placer | Pardee, 1918 |
| 13 | Bilk & Weasel Gulch | 4 | 12N | 13W | Gold | placer | Pardee, 1918 |
| 14 | Boston Mine | 5 | 12N | 13W | Gold, copper, silver | u/g op, caved; copper skarn | Pardee, 1918 |
| 14 | Gold Leaf | 5 | 12N | 13W | Gold | u/g and surface cuts produced 340 oz Au, ave. grade 0.44 oz Au/t | Kauffman, 1963 |

## TABLE II (Cont.)

## MINERAL OCCURRENCES AND DEPOSITS IN THE GARNET GRA, MONTANA

| Map No. | Name | Location Sec. | T. | R. | Commodity | Description | Reference |
|---|---|---|---|---|---|---|---|
| 14 | Gold Angel | 5 | 12N | 13W | Gold, copper | copper skarn | Pardee, 1918 |
| 14 | Lehson Mine | 5 | 12N | 13W | Gold | placer | Pardee, 1918 |
| 14 | Hartford Mine | 5 | 12N | 13W | Gold, copper, silver | skarn | Pardee, 1918 |
| 14 | Nelson and Dan | 5 | 12N | 13W | Copper, gold, skarn | unknown | MILS |
| 14 | Pearl Mine | 5 | 12N | 13W | Copper, gold, skarn | 300 shaft with several levels in skarn body produced about 1,000 oz Au | Pardee, 1918 |
| 14 | Red Rock | 8 | 12N | 13W | Gold | u/g and surface cuts qtz-sulfides veins, produced 580 oz Au | Pardee, 1918 |
| 14 | Deep Creek | 8 | 12N | 13W | Gold | placer | MILS |
| 15 | Mountain Mine | 8 | 12N | 13W | Gold | u/g op, caved; copper skarn, produced 16% Cu ore in 1916 | Pardee, 1918 |
| 16 | Arkansaw Mine | 1 | 12N | 14W | Gold | quartz vein assayed from 1.9 to 3.9 oz Au/t | Pardee, 1918 |
| 16 | Alabama Mine | 12 | 12N | 14W | Gold | u/g, caved | Pardee, 1918 |
| 16 | Dandy Mine | 12 | 12N | 14W | Gold, zinc, silver | u/g, caved; 630 oz Au produced 1916 | Pardee, 1918 |
| 16 | Herzler and Green | 12 | 12N | 14W | Gold, silver | unknown | MILS |
| 16 | Independence Prospect | 12 | 12N | 14W | Gold | u/g, caved; no recorded production | Pardee, 1918 |
| 16 | Lynx Mine | 12 | 12N | 14W | Gold | cave 165' adit following qtz-pyrite vein with up to 3 oz Au/t | Pardee, 1918 |
| 16 | Masculine Mine | 12 | 12N | 14W | Gold | qtz-pyrite vein, 175' caved shaft, 0.9 to 2 oz Au/t | Pardee, 1918 |
| 16 | Ohio & Buckeye | 12 | 12N | 14W | Gold | qtz-pyrite vein | Pardee, 1918 |
| 17 | Stone Placer Mine | 12 | 12N | 14W | Gold | placer | MILS |

## TABLE II (Cont.)

## MINERAL OCCURRENCES AND DEPOSITS IN THE GARNET GRA, MONTANA

| Map No. | Name | Location Sec. | T. | R. | Commodity | Description | Reference |
|---|---|---|---|---|---|---|---|
| 18 | Haparanda | 12 | 12N | 14W | Gold | qtz-pyrite vein; 480 oz Au from 1906 to 1916 | Pardee, 1918 |
| 19 | Mascotte Mine | 15 | 12N | 8W | Copper, silver, gold | unknown | MILS |
| 20 | Bulky Gulch | | | | | unknown | MILS |
| 21 | Lenore and Myrna | 16 | 12N | 13W | Mercury | unknown | MILS |
| 22 | Baker and Sullivan | 19 | 12N | 13W | Lead, silver | 4'x40'galena in limestone, produced $11,000 of ore by 1916 | Pardee, 1918 |
| 23 | Unknown | | 12N | 14W | Lead | unknown | Pardee, 1918 |
| 24 | Bluebird | 22 | 13N | 13W | Copper, gold, silver | u/g, unknown | MILS |
| 25 | Your Name Placer | 17 | 13N | 12W | Gold, tungsten, copper, lead | placer | MILS |
| 26 | Royal Mine | 16 | 13N | 11W | Gold, silver | u/g, unknown | MILS |
| 27 | Douglas Creek | | 12N | 12W | Bentonite | unknown | MILS |
| 28 | Tie Gulch | 6 | 11N | 13W | Limestone | unknown | MILS |
| 29 | Hitchcock Quarry | 3 | 11N | 13W | Limestone | unknown | MILS |
| 30 | Spring Gulch | 10 | 11N | 13W | Limestone | unknown | MILS |
| 31 | Unnamed | 23 | 11N | 11W | Phosphate | unknown | MILS |
| 32 | El Dorado Mine | 11 | 11N | 12W | Gemstone | unknown | MILS |
| 33 | Bohrer Bar | 12 | 11N | 12W | Gold, lead, zinc | unknown | MILS |
| 34 | Morris Creek | 15 | 11N | 12W | Limestone | unknown | MILS |
| 35 | Spring Gulch | 22 | 11N | 12W | Limestone | quarry | MILS |
| 36 | Unnamed | 24 | 11N | 12W | Limestone | unknown | MILS |
| 37 | Edwards Gulch | 29 | 11N | 12W | Limestone | quarry | MILS |
| 38 | Jens | 3 | 11N | 10W | Limestone | quarry | MILS |
| 39 | Hoover Creek | 13 | 11N | 11W | Phosphate | unknown | MILS |
| 40 | Silver Reef Mine | 26 | 11N | 10W | Silver | u/g unknown | MILS |

The orebodies in the Garnet district are in three principal vein systems, spaced a quarter of a mile apart: (1) the Nancy Hanks zone (northernmost), a composite vein or zone cutting granodiorite belonging to the Garnet stock; (2) the Magone and Anderson vein; and (3) the Red Cloud vein (southernmost). Both the Magone and Anderson vein and the Red Cloud vein follow bedding planes in schist or quartzite (Pardee, 1918).

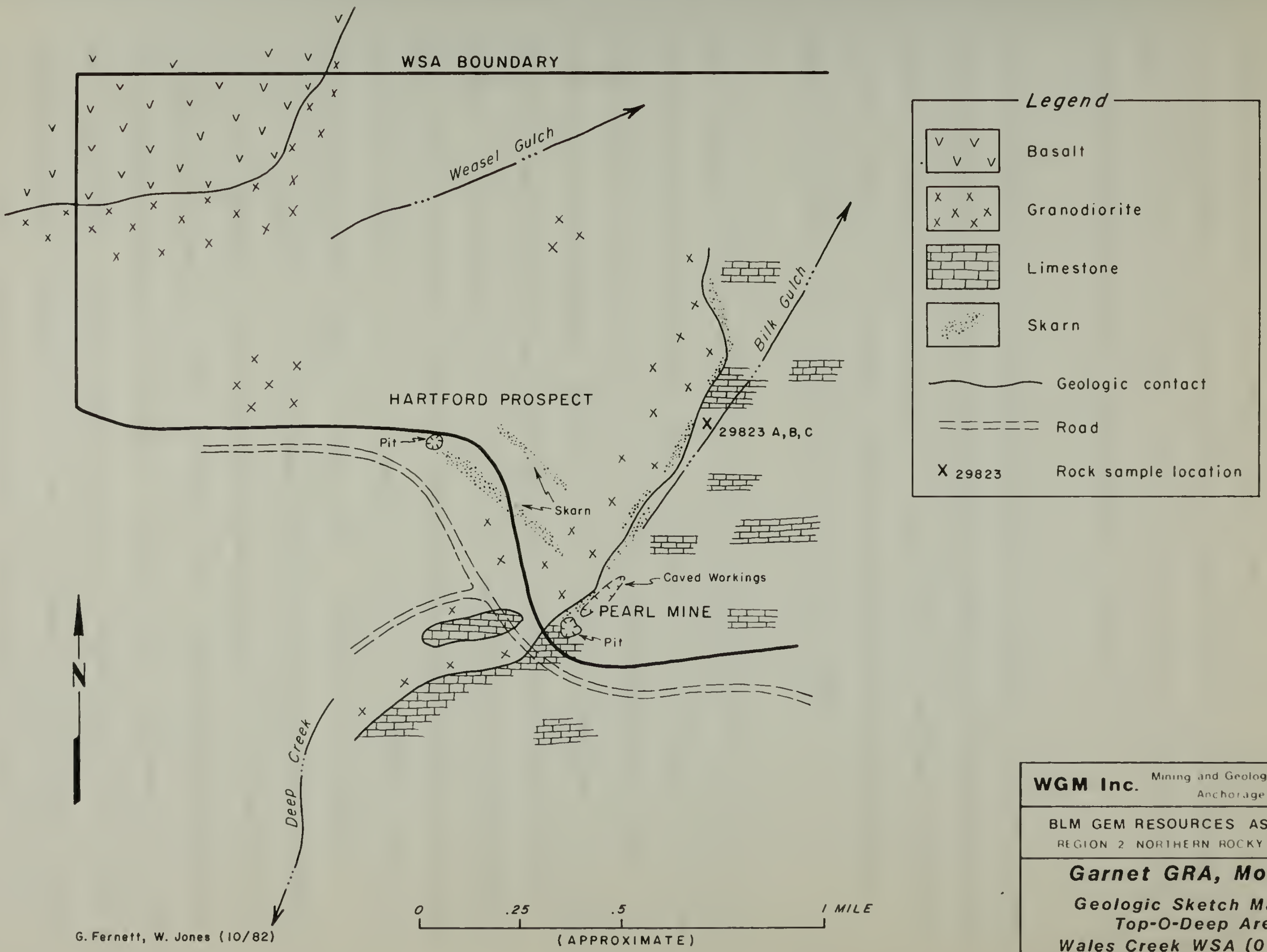
The Nancy Hanks vein system is a 1½ mile long composite gold-bearing quartz-sulfide vein or zone of veins which hosted (from east to west) the Shamrock, Dewey, Nancy Hanks and Cascade mines. The Spokane vein is probably the western extension of this vein. The Nancy Hanks dips 30°N, strikes roughly east-west and is somewhat arcurate; concave to the north. Individual veins were three to four feet thick, averaging one to three feet. Virtually all of the vein material constituted ore where thick enough to mine. The ore consisted of auriferous pyrite, chalcopyrite and tetrahedrite in a quartz-barite±carbonate gangue. Ore from the Nancy-Hanks averaged four ounces per ton gold, ten ounces per ton silver, and three to four percent copper. The Dewey mine produced ore grading 3.5 ounces per ton gold , 6.5 ounces per ton silver and three to four percent copper. Free milling gold occurred where the veins were oxidized, a condition which often reached in excess of 100 feet. The orebodies were irreguarly-shaped, raked slightly westward and rarely persisted to depths of more than 500 or 600 feet (Pardee, 1918).

The Magone and Anderson vein occupies a bedding plane in quartzite and schist that strikes east and has an average dip of 30°N. The Grant and

Hartford mine is located on the western end of the vein. After interruption of continuity by a northeasterly fault zone near the east end of the Grant and Hartford property, the vein reappears farther east in the Magone and Anderson mine. Thus the vein persists for at least 1,500 feet. The vein ranges from 6 inches to 2 feet in width and mining reached a depth of 500 feet, measured on the vein. Vein minerals normally consist of quartz, barite, ankerite, and calcite which often exhibit a banded structure due to partial or complete replacement of the enclosing schist. Pyrite is the most common sulfide with rare tetrahedrite present. Orebodies were shaped like small, flat lenses with a maximum thickness of three feet. Oxidized ore from small stopes contained from 1/2 up to five ounces per ton of gold. The silver:gold ratio was generally 1:1 (Pardee, 1918).

The Crescent, Lead King, and Red Cloud mines exploited the Red Cloud vein, a precious metal-bearing quartz-sulfide vein set which cuts hornfelsed schist and quartzite. The vein strikes N50-70°W and dips 25-35°NE. It persisted for a half mile along strike and at least 800 feet down-dip. The average thickness was two or more feet. Two separate orebodies, one with a stope length of 500 to 700 feet, were exploited. Vein minerals consisted of pyrite, chalcopyrite, tetrahedrite, and galena with quartz and minor barite gangue. Ore grade averaged one ounce per ton gold and 1½ ounce per ton silver (Pardee, 1918).

The Coloma district is located two miles northwest of Garnet, in Missoula County, just at the western boundary of the Garnet GRA. The largest mines, the Mammoth and the Comet (not shown on Fig. 7), were located on gold-bearing quartz veins in granodiorite near its contact with Jefferson



G. Fernett, W. Jones (10/82)

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**Garnet GRA, Montana**

**Geologic Sketch Map of
Top-O-Deep Area,
Wales Creek WSA (075-151)**

|  |  |  |
|---|---|---|
| AS SHOWN |  | 7 |
| WGM | 1/1983 |  |
| DSI | GF |  |

Limestone. The veins strike east-northeast and dip 30°S. Generally, they are not more than one to two feet wide, but they persist up to 500 feet, both along strike and down-dip. The veins are similar in mineralogy and appearance to the Nancy Hanks zone at Garnet (Pardee, 1918).

The Top O'Deep district, discovered in 1866, is located at the head of Deep Creek immediately adjacent to the southwest boundary of the Wales Creek WSA. The Deep Creek basin is almost entirely underlain by granodiorite which has intruded limestone. Lode mines have exploited both contact metasomatic deposits and quartz veins in the district (Pardee, 1918).

Contact metasomatic deposits were mined at the Mountain (loc. 15, Fig. 6), Pearl, Boston and Hartford (all loc. 14, Fig. 6) mines. They are in skarns which developed along the eastern flank of a granodiorite plug at the contact zone with Devonian limestone of the Jefferson Formation. The skarns are irregularly-shaped, generally elongated parallel with the intrusive contact. At the Boston mine the skarns are developed in a crescent-shaped roof pendant 3,000 feet or more in length and 500 feet in width. The skarn at the Pearl mine is 10 to 50 feet wide, at least 300 feet deep, and has a discontinuous strike length of a half mile. The skarns are composed primarily of massive to faintly banded andradite garnet, magnetite, epidote, quartz and tremolite. Contacts with the wallrocks, either granodiorite or limestone, are generally sharp (Pardee, 1918). WGM personnel visited the Pearl and Hartford mine sites (Fig. 7, Appendix III). The mines are caved and inaccessible. The Pearl mine consists of a caved 8 by 12 foot shaft in granodiorite near its contact with coarse-grained skarn and marble. Minor malachite staining occurs in the veined zone and no relic sulfides were

noted. The Hartford mine is in a fine- to coarse-grained garnet-epidote skarn developed in a pendant within a granodiorite satellite of the Garnet Stock (Fig. 7). The granodiorite is strongly sericitized for several feet away from the skarn. Skarn talus extends for at least 800 feet towards the Pearl mine to the southeast. Analytical results from three grab samples of skarn collected in Bilk Gulch north of the Pearl mine and east of the Hartford mine indicate that the skarn is locally anomalous in copper, lead, gold, and silver (Table III).

Gold-bearing quartz veins were exploited by the Red Rock and Gold Leaf mines. The veins are commonly an inch or two wide, but widths up to a foot or more are reported. They form ore zones up to a foot thick, 30 to 40 feet in length and up to 200 feet in depth. Oxidation extends 40 to 50 feet below the surface. The veins carry auriferous pyrite, chalcopyrite and native gold (Pardee, 1918). Kauffman (1963) reported that the workings of the Gold Leaf mine include a 484 foot long adit with one small raise to the surface, and a 40 foot winze. A three-foot channel sample including six inches of vein contained 0.44 ounces gold per ton and 0.15 ounces silver per ton.

The lodes at the head of Elk Creek (loc. 16, Fig. 6) are in quartz-pyrite veins which occupy fractures in granodiorite and sedimentary rocks. Except for the Haparanda mine where the veins strike north, the trend is northeast and most of them dip steeply northwest. Generally they are narrow but fairly persistent. At the Dandy mine, the veins extend 1,000 feet or more along strike and at least 500 feet down-dip. Width of the veins varies, but it can average up to two feet for considerable distances (Pardee, 1918).

## TABLE III

## GEOCHEMICAL ANALYSES FROM THE TOP O'DEEP DISTRICT WALES CREEK WSA*

| Sample No. | Description | Cu (ppm) | Pb (ppm) | Zn (ppm) | Mo (ppm) | W (ppm) | Au (ppm) | Ag (ppm) |
|---|---|---|---|---|---|---|---|---|
| 29828A | Coarse-grained garnet-epidote-diopside(?) skarn. Grab sample. | 375 | 20 | 20 | 3 | 2 | .13 | .2 |
| 29828B | Coarse-grained garnet-diopside skarn cut by veinlets of coarse-grained specular hematite; disseminated malachite. Grab sample. | 1500 | 25 | 325 | 2 | 5 | .14 | 6.0 |
| 29828C | Red colored fine-grained limestone(?). | 240 | 415 | 70 | <2 | 5 | .11 | 4.0 |

---

* Analyses by Rainbow Resource Labs, Inc. of Anchorage, Alaska. Sampling by WGM Inc.

The Baker and Sullivan mine (loc. 22, Fig. 6) located 4½ miles southeast of Garnet in sec. 3, T.12N., R.14W. produced silver-lead ore from a four-foot thick lens of galena localized in fractured Silver Hill Limestone. The limestone is extensively silicified, and the orebody is along the axis of a northwesterly trending anticline (Pardee, 1918).

The gold placer deposits occur along Bear and Elk Creeks, and their tributary streams which head in the area between the Top O'Deep and Coloma districts (Lyden, 1948). Bilk and Weasel gulches which discharge eastward from Top O'Deep into the Wales Creek WSA are also gold bearing (Pardee, 1918). A 32 ounce gold nugget, reportedly the largest nugget found in Montana, was found just east of Top O'Deep (Earll, 1972). Most of Your Name Creek is excluded from the Wales Creek WSA and nearly bisects the WSA into two parcels (Appendix I).

Limestone has been quarried from several sites in the south-central part of the Garnet GRA. Quarries located in Rattler Gulch (loc. 30, Fig. 6) and Edwards Gulch (loc. 37, Fig. 6) mine the upper part of the Madison Group limestones (Kauffman, 1963). The stone is reported to average 98% $CaCO_3$ (Perry, 1959). The gastropod limestone member of the Kootenai Formation was formerly quarried near Drummond (Gwinn, 1961). Analyses of samples of carbonate rocks in the GRA compiled from Chelini (1975) and Hanson (1952) are given in Table IV.

There are no known energy deposits in the Garnet GRA.

## TABLE IV

## ANALYSES OF CARBONATE ROCKS IN THE GARNET GRA, MONTANA

| Sample No. | Location Sec. | T. | R. | Formation | Analysis CaO(%) | MgO(%) | Insol(%) | Source of Data |
|---|---|---|---|---|---|---|---|---|
| LS-58 | 32 | 11N | 12W | Kootenai (Gastropod LS) | 48.8 | 0.88 | 9.38 | Chelini, 1975 |
| LS-59 | 3 | 11N | 13W | Mission Canyon | 49.66 | 2.55 | 4.83 | Chelini, 1975 |
| LS-60 | 3 | 11N | 13W | Lodgepole | 40.94 | 0.54 | 24.57 | Chelini, 1975 |
| LS-65 | 15 | 11N | 12W | Jefferson | 53.5 | 0.9 | 0.9 | Chelini, 1975 |
| LS-66 | 22 | 11N | 12W | Madison | 54.4 | 0.6 | 0.4 | Chelini, 1975 |
| LS-67 | 22 | 11N | 12W | Madison | 48.0 | 0.1 | 11.0 | Chelini, 1975 |
| LS-68 | 11 | 11N | 14W | Madison | 45.5 | 0.1 | 17.4 | Chelini, 1975 |
| LS-69 | 11 | 11N | 14W | Madison | 28.4 | 9.3 | 27.4 | Chelini, 1975 |
| ----- | "Garnet Range" | | | Silver Hill | 52.7 | 1.2 | 1.6 | Hanson, 1952 |
| ----- | "Garnet Range" | | | Silver Hill | 41.4 | 7.5 | 3.5 | Hanson, 1952 |

## 3.2 Known Mineral and Energy Prospects, Occurrences and Mineralized Areas

In addition to the mines described above, there are numerous mineral occurrences and prospects in the Garnet GRA (Fig. 6). Many of these occurrences are in the same area and are similar to the deposits described in section 3.1. Brief descriptions of these are given in Table II and they will not be discussed again in this section.

MILS files list several occurrences in the Garnet GRA for which very little data exists. They are:

1. the Blue Bird precious and base metal occurrence (loc. 24, Fig. 6) within the Wales Creek WSA on upper Your Name Creek; sec. 22, T.13N., R.13W. (MILS). No information on the prospect is given other than that it was an underground operation. The general area is underlain by the Precambrian Mount Shields Formation (Wallace et al., 1978, 1981).

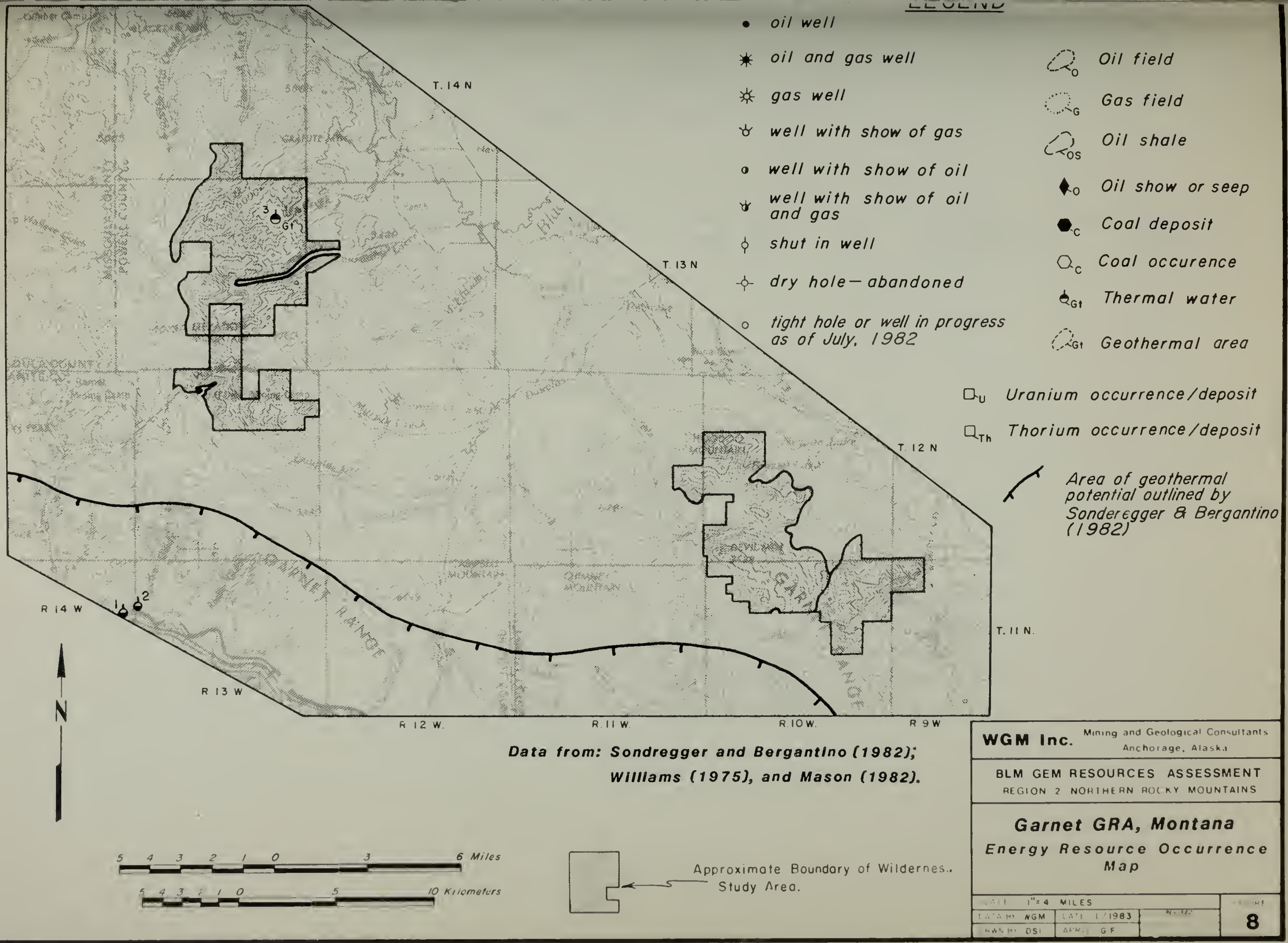
2. the Bohrer occurrence (loc. 33, Fig. 6), a base and precious metal prospect of unknown type in the south-central part of the GRA; sec. 12, T.11N., R.12W. The area is underlain by Tertiary andesitic volcanics (Wallace et al., 1978, 1981).

3. the Silver Reef mine (loc. 40, Fig. 6), a silver prospect reportedly developed by underground workings, one mile south of the Gallagher Creek WSA (075-151B) in sec. 25, T.11N., R.10W. This prospect also occurs in an area apparently underlain by Tertiary andesitic volcanics (Wallace et al, 1978, 1981).

4. a mercury prospect (loc. 21, Fig. 6), covered by the Lenore and Myrna claims in sec. 16, T.12N., R.13W., immediately south of the Wales Creek WSA (075-150).

MILS files show two phosphate occurrences (loc. 31 and 39, Fig. 6) in the south-central part of the Garnet GRA in areas underlain by the Phosphoria Formation. Phosphate has been produced from the Phosphoria southeast of the GRA in the Garrison district and is presently being mined just east of the GRA. In the Garrison district the Phosphoria is 65 to 70 feet thick. The ore horizon, the Retort Phosphorite Member, is a 3-5 foot thick oolitic phosphorite bed (Popoff and Service, 1965). The average $P_2O_5$ content is approximately 4%. Approximately seven million tons of phosphate ore have been produced from the district since 1929. Reserves remaining are estimated at 27 to 59 million tons (Pardee, 1921; Popoff and Service, 1965). The Phosphoria becomes thinner and increasingly sandy to the west. Northwest of Drummond the Retort Phosphorite Member consists of slightly phosphatic sandstone. Popoff and Service (1965) consider the unit to be too thin and of too low phosphorite content to be mineable west of the Garrison district.

There are two thermal springs in the southern part of the Garnet GRA (loc. 1 and 2, Fig. 8, Table V). These are part of a large area of warm springs located around Bearmouth (Sonderegger and Bergantino, 1982). The springs and surrounding areas were studied by Williams (1975). He reports that the two springs have discharges of 200-600 gpm and surface temperatures of 17-23°C (Table V). Silica and Na-K-Ca geothermometers indicate subsurface temperatures of 50-55°C (Williams, 1975). There are also several warm



**Data from: Sondregger and Bergantino (1982); Williams (1975), and Mason (1982).**

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**Garnet GRA, Montana**
**Energy Resource Occurrence Map**

| | | |
|---|---|---|
| SCALE 1"=4 MILES | | FIGURE |
| DATA BY WGM | DATE 1/1983 | 8 |
| DRAWN BY DSI | APPR. GF | |

## TABLE V

## THERMAL SPRINGS OF THE GARNET GRA*

| Map No. | Name | Location | | | Source Rock | Observed Temp. (C$^o$) | pH | Specific Conductance | Total Dissolved Solids |
|---|---|---|---|---|---|---|---|---|---|
| | | Sec. | T. | R. | | | | | |
| 1 | Bearmouth | 12 | 11N | 14W | Madison | 23 | --- | --- | --- |
| 2 | Unnamed | 11 | 11N | 14W | Madison | 17 | 7.6 | 642 | 480 |
| 3** | Wales Creek | 12 | 13N | 13W | Cretaceous Intrusive | -- | --- | --- | --- |

---

* Data from Sonderegger and Bergantino (1981) and Williams (1975).

** Mindy Mason pers. comm. (1982).

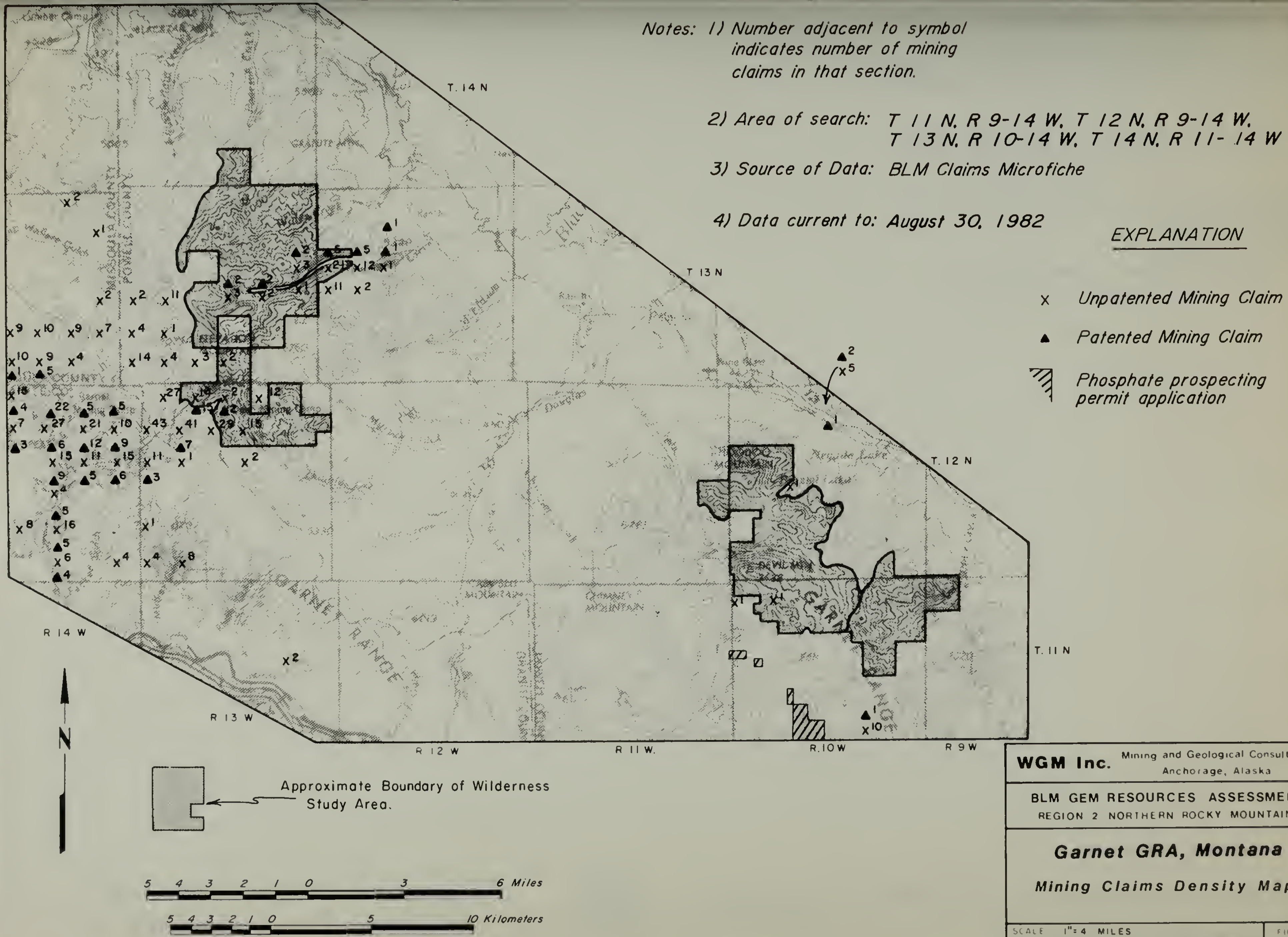
springs on Wales Creek (Mindy Mason pers. comm., 1982). However, these springs are not shown by either Sonderegger and Berantino (1981) or Cole et al. (1982) and there is no temperature data available for the springs. Burlington Northern conducted geologic work in the Wales Creek area to evaluate the geothermal potential of the area (Mindy Mason pers. comm., 1982), but the results of their work are not known.

## 3.3 Mining Claims, Leases and Material Sites

A review of BLM records current to August 30, 1982 shows that there are approximately 554 unpatented and 152 patented mining claims within the Garnet GRA (Fig. 9). There are approximately 44 unpatented and 23 patented mining claims, both lode and placer, in or surrounded by WSA 075-150 (Table VI). Virtually all of Your Name Creek is covered by patented and unpatented claims as is the Top O'Deep district. One unpatented claim is located in WSA 075-151A and two more are close to the boundary of the WSA. One or both of the latter may also be in the WSA. Oil and gas lease plats current to August 4, 1982 were reviewed (Fig. 10, Table VII). Approximately 95% of WSA 075-151A, 75% of WSA 075-150 and 50% of WSA 075-151B are covered by leases. The remaining 50% of WSA 075-151B is covered by lease applications.

## 3.4 Mineral and Energy Deposit Types

The Garnet GRA encompasses a diverse geologic terrane that has the potential to host a variety of mineral deposits. Previously discussed known mineral deposits and occurrences encompass several types: (1) gold-bearing quartz-sulfide veins in intrusives and wallrocks, (2) quartz-tetrahedrite bearing



Notes: 1) Number adjacent to symbol indicates number of mining claims in that section.

2) Area of search: T 11 N, R 9-14 W, T 12 N, R 9-14 W, T 13 N, R 10-14 W, T 14 N, R 11- 14 W

3) Source of Data: BLM Claims Microfiche

4) Data current to: August 30, 1982

EXPLANATION

| | |
|---|---|
| x | Unpatented Mining Claim |
| ▲ | Patented Mining Claim |
| ▨ | Phosphate prospecting permit application |
| ▭ | Approximate Boundary of Wilderness Study Area. |

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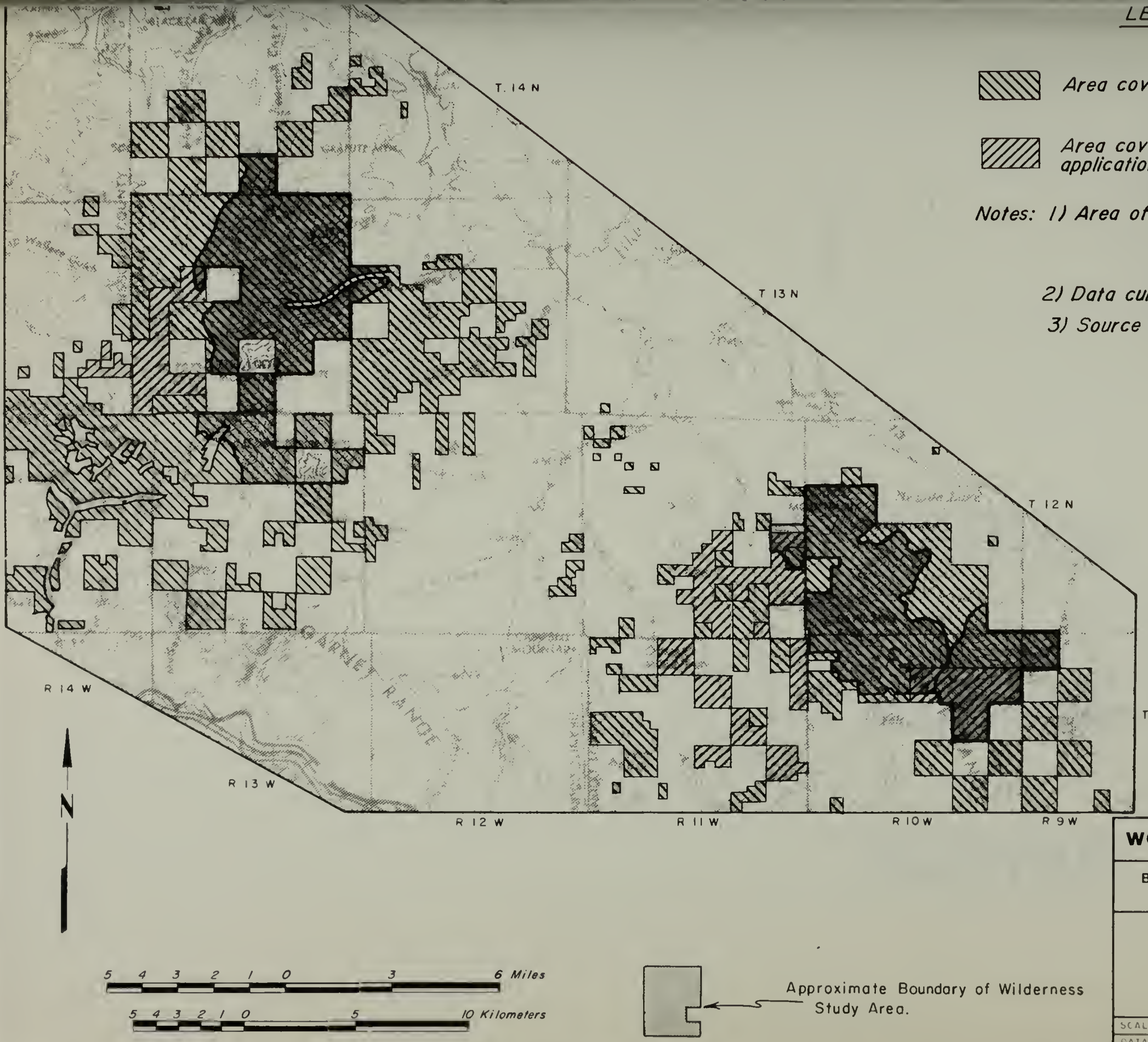
BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

**Garnet GRA, Montana**

**Mining Claims Density Map**

| | | |
|---|---|---|
| SCALE 1" = 4 MILES | | FIGURE |
| DATA BY WGM | DATE 1/1983 | 9 |
| DRWN BY DSI | APPVL G F | |



Approximate Boundary of Wilderness Study Area.

LEGEND

▧ *Area covered by oil and gas leases.*

▨ *Area covered by oil and gas lease application.*

*Notes: 1) Area of Search: T 11 N, R 9-11 W,*
*T 12 N, R 9-13 W,*
*T 13 N, R 10-13 W,*
*T 14 N, R 12-13 W*
*2) Data current to: August 4, 1982*
*3) Source of Data: BLM OG Plats*

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

**Garnet GRA, Montana**

***Oil and Gas Lease Status***

| | | | |
|---|---|---|---|
| SCALE 1"= 4 MILES | | | FIGURE |
| DATA BY WGM | DATE 1/1983 | | 10 |
| DRWN BY DSI | APRVD G F | | |

## TABLE VI

## MINING CLAIMS IN WILDERNESS STUDY AREAS IN THE GARNET GRA, MONTANA

| Wilderness Study Area | Claim Serial Numbers | | |
|---|---|---|---|
| 075-150 | 5599 | 44747 | 70882 |
| | 7598 | 44748 | 70883 |
| | 37159 | 44749 | 70884 |
| | 37160 | 44750 | 70885 |
| | 40740 | 44551 | 70886 |
| | 44728 | 44755 | 70887 |
| | 44735 | 44756 | 77823 |
| | 44737 | 44757 | 77829 |
| | 44744 | 67420 | 77830 |
| | 44745 | 70880 | 80045 |
| | 44746 | 70881 | 80619 |
| 075-151A, B | 81117 | | |
| | 81118 | | |
| | 63929 | | |

## TABLE VII

## OIL AND GAS LEASES IN WILDERNESS STUDY AREAS IN THE GARNET GRA, MONTANA

| Wilderness Study Area | Lease Numbers | |
|---|---|---|
| 075-150 | M 35928 | M 45447 |
| | M 39818 | M 45762 |
| | M 39820 | M 45763 |
| | M 45391 | M 45866 |
| | M 45392 | M 45971 |
| | M 45423 | M 45975 |
| | M 45427 | M 45141 |
| | M 45443 | M 46619 |
| 075-151A, B | M 39811 | M 45403 |
| | M 39816 | M 45404 |
| | M 39817 | M 45410 |
| | M 45396 | M 45438 |
| | M 45397 | M 45441 |
| | M 45401 | M 45442 |
| | M 45402 | M 45484 |

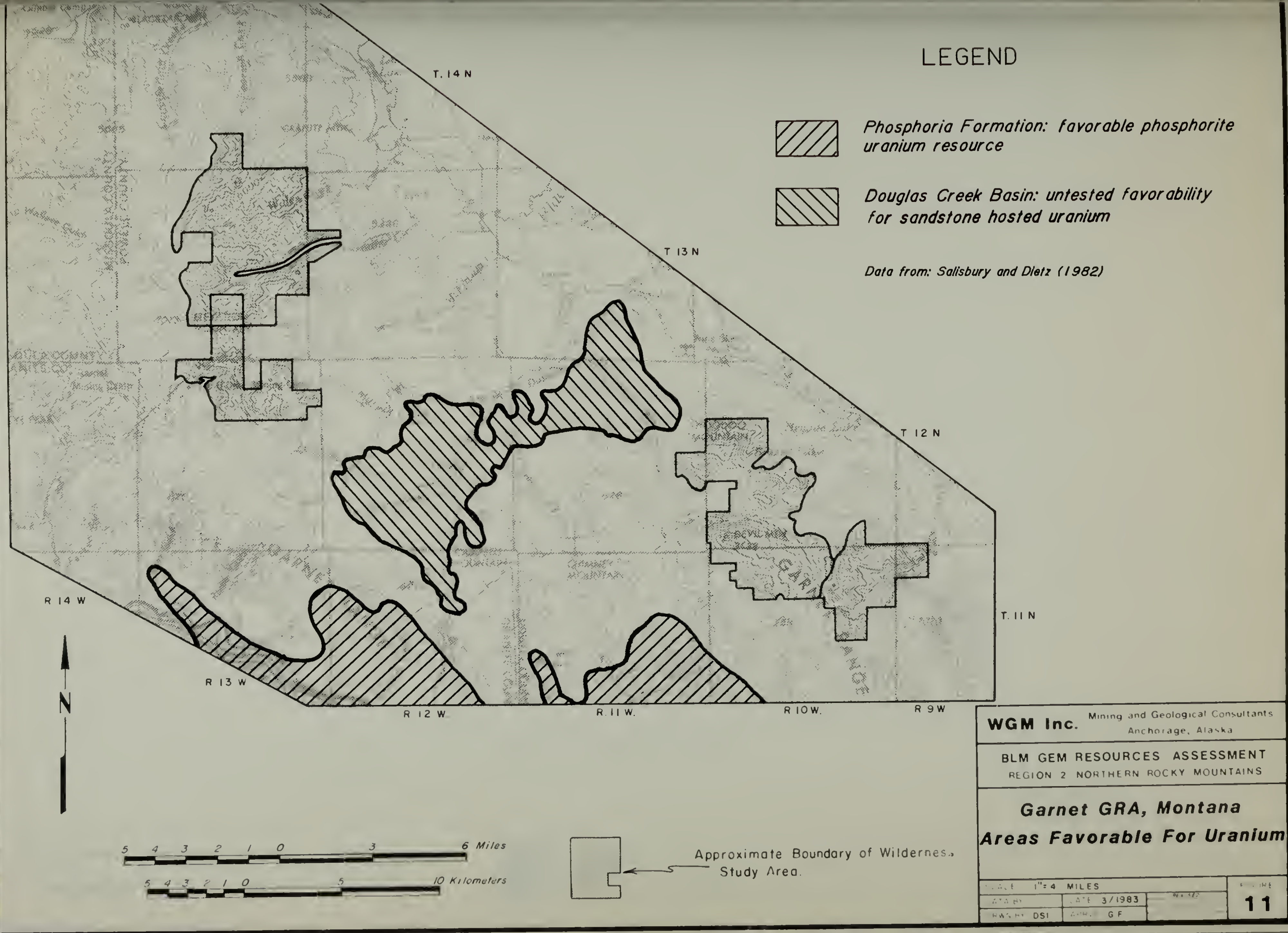
veins, (3) base and precious metal-bearing skarns, (4) lead-zinc replacement deposits in carbonate rocks, (4) gold placers, (5) phosphate deposits, and (6) high calcium limestone. In addition, the geologic setting suggests the possibility of several additional types of mineralization including, (1) stratabound copper deposits in Beltian sedimentary rocks, (2) breccia-hosted Mississippian Valley-type lead-zinc deposits, (3) low grade bulk tonnage disseminated/stockwork gold deposits, and (4) sediment- and phosphorite-hosted uranium deposits.

Stratabound copper±silver mineralization is common in the green bed zone in parts of the Snowslip and upper Mt. Shields Formation in the Belt Basin (Harrison, 1972, 1974; Clark, 1971). Kauffman (1963) reports disseminated copper mineralization occurring in the Mt. Shields Formation in the Nimrod area approximately five miles southwest of the Garnet GRA. Similar rocks occur in the GRA and potential exists for this type of mineralization.

Mississippi Valley-type deposits are stratabound lead-zinc deposits in carbonate rocks, generally within sedimentary and collapse breccia zones. Mississippi Valley deposits have not been reported in the Garnet GRA, but the occurrence of solution collapse breccias in Paleozoic carbonate rocks is widespread regionally in the Paleozoic section. Extensive collapse breccias occurring in the Devonian Jefferson Limestone (Sloss and Laird, 1947) the Mississippian Madison Group (Kauffman, 1963), the Cambrian Silver Hill and Red Lion Formation, and the Devonian Maywood (Ruppel et al., 1981) constitute a favorable host environment for Mississippi Valley-type mineralization.

In recent years low grade (often less than 0.1 ounces of gold per ton) but large tonnage gold orebodies have been exploited. These deposits consist of disseminations or stockworks in igneous plugs, stocks, dikes and sills; altered zones within volcanic flows principally of Tertiary and Mesozoic age; and in various types of sedimentary rocks. The principal economic element in these deposits is gold with small amounts of silver although a few deposits yield base metals (Boyle, 1979). The gold in these deposits often occurs as microscopic or sub-microscopic grains (Elevatorski, 1981). The structural disturbance of the rocks present in the Garnet GRA followed by igneous intrusion of the disturbed rocks coupled with the presence of known intrusive-related gold mineralization within the GRA indicates that the potential for the occurrence of low grade, bulk tonnage disseminated/stockwork gold deposits in the GRA is good.

During the past several years the U.S. Geological Survey has been systematically studying the Butte Quadrangle as part of the CUSMAP program. Many of the samples collected during the NURE program were also analyzed for base metals, however the data is not particularly useful due to the low precision of the analytical techniques. Geologic map data from the CUSMAP program are available (Wallace et al., 1977, 1978, 1981) and some of the geochemical data was recently published (Campbell et al., 1982). Aeromagnetic surveys of the Butte Quadrangle have been completed but the data compilation is still in progress (W.F. Hanna, oral comm., 1982). Similarly, the mineral resource evaluation program has begun but considerable work remains (J.E. Elliott, oral comm., 1982). The U.S. Geological Survey data applicable to the Garnet GRA are included in Appendix IV and sample locations are shown on Figure 12.



LEGEND

▨ Phosphoria Formation: favorable phosphorite uranium resource

▨ Douglas Creek Basin: untested favorability for sandstone hosted uranium

Data from: Salisbury and Dietz (1982)

Approximate Boundary of Wilderness Study Area.

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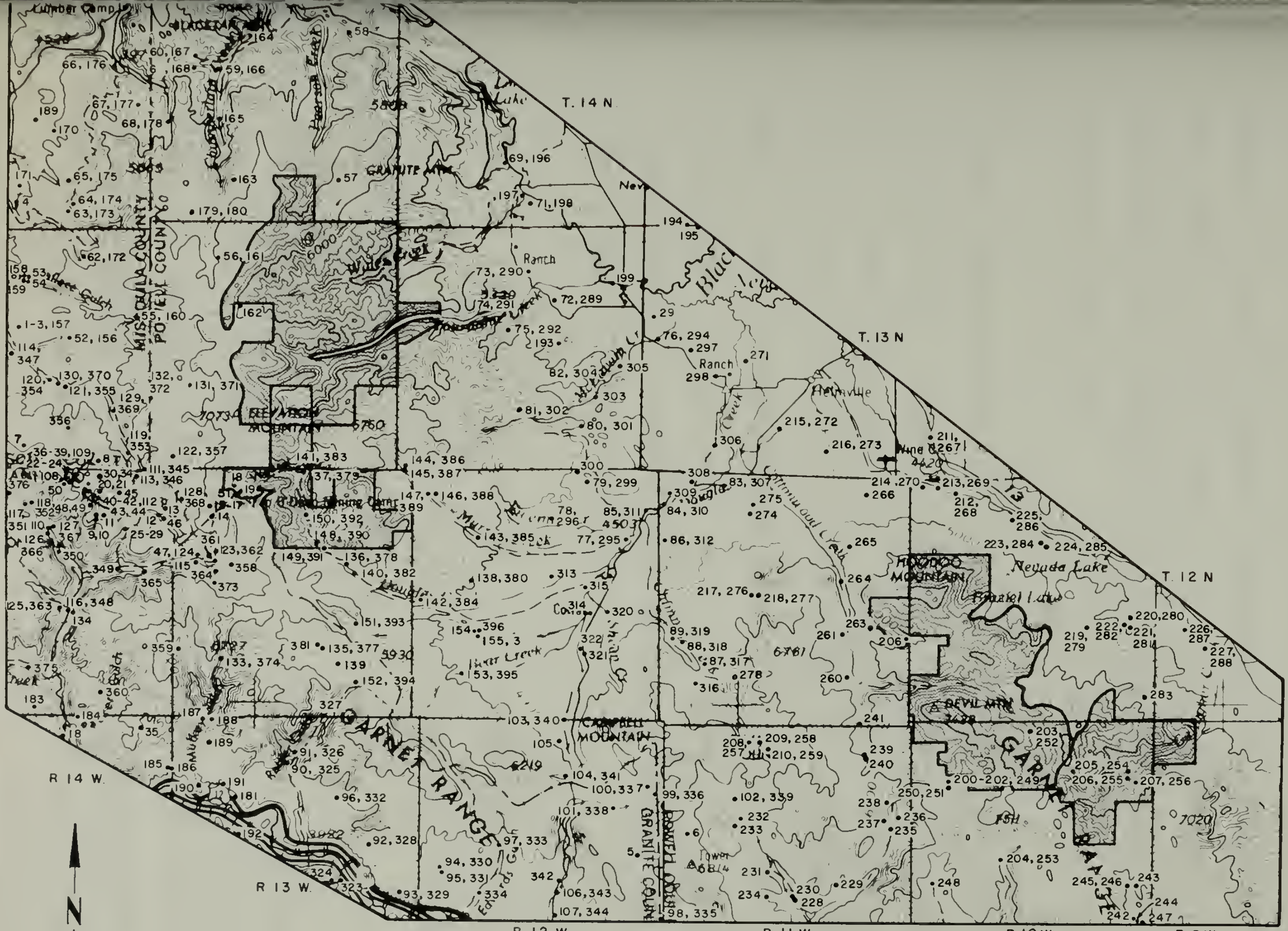
BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

**Garnet GRA, Montana**
**Areas Favorable For Uranium**

SCALE 1"=4 MILES
DATE 3/1983
DRAWN BY DSI
APPR. GF
FIGURE 11



*Data from Campbell et.al, (1982).*

5 4 3 2 1 0 3 6 Miles

5 4 3 2 1 0 5 10 Kilometers

▨ Approximate Boundary of Wilderness Study Area.

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

## Garnet-GRA, Montana
## U. S. Geological Survey
## Geochemical Sample Locations

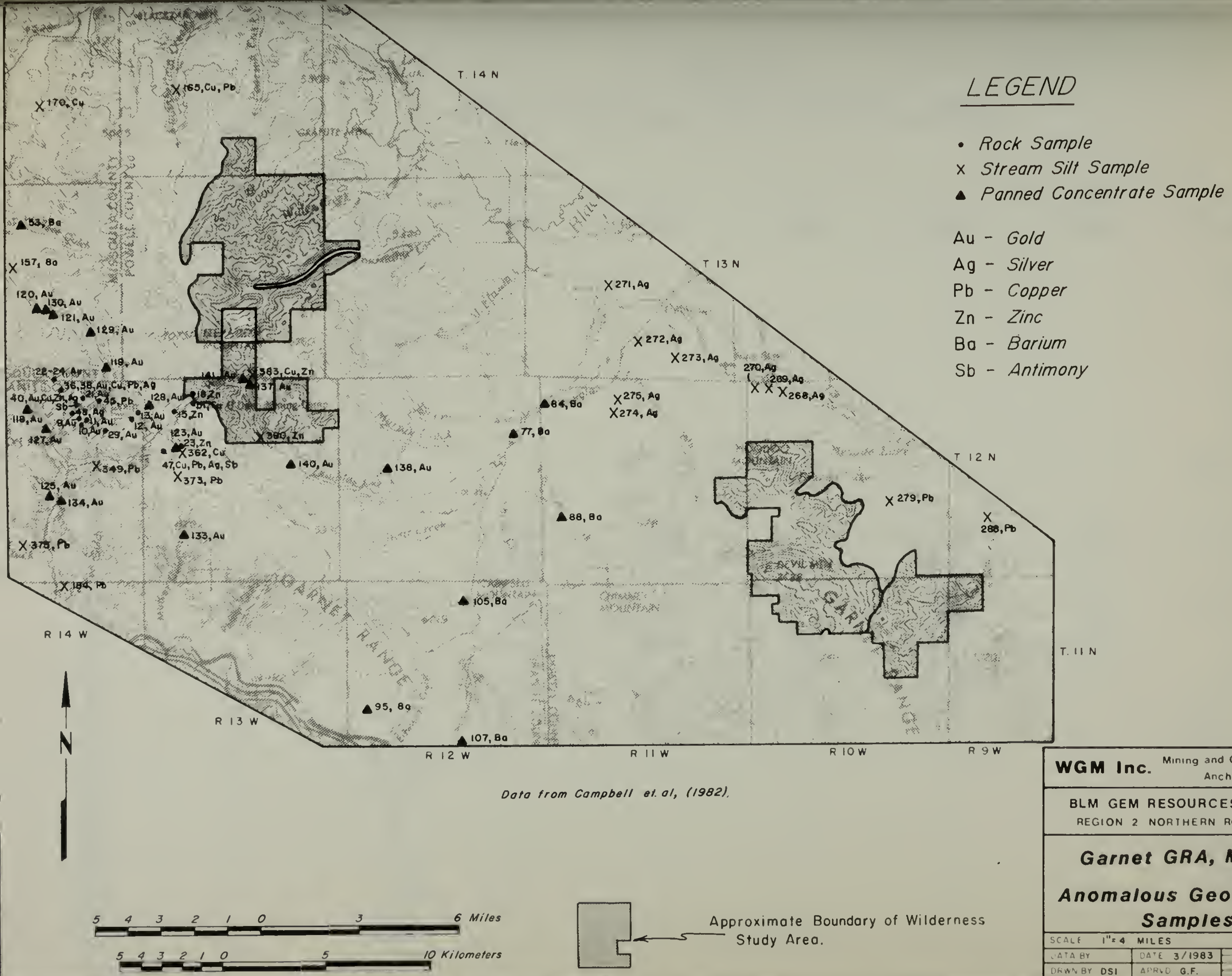
| | | | FIGURE |
|---|---|---|---|
| SCALE 1"=4 MILES (1 250,000) | | | 12 |
| DATA BY | DATE 9/1982 | Rv.slc | |
| DRWN BY OSI | APRVD G F | | |

A total of 396 samples, including 51 rocks, 131 panned concentrate and 214 stream sediment samples, have been collected in the Garnet GRA by the U.S. Geological Survey (Campbell et al., 1982) and analyzed by atomic absorption methods. Ten samples (no. 18, 19, 137, 141, 148, 150, 379, 383, 390 and 392) were collected from the Wales Creek WSA, two from the Hoodoo Mountain WSA (no. 203 and 252), and six from the Gallagher Creek WSA (nos. 205, 206, 207, 254, 255 and 256). Fifty of the samples collected within the GRA are considered to be anomalous in gold, silver, lead, copper, zinc and barium (Table VIII, Fig. 13).

Several samples from the Wales Creek WSA (075-150) are anomalous in gold, copper and lead. A panned concentrate sample from Bilk Gulch (no. 141, Fig. 13) is strongly anomalous in gold (46.3 ppm) and a silt sample from the same site (no. 383, Fig. 13) is weakly anomalous in copper (50 ppm) and lead (54 ppm). A panned concentrate sample (no. 137, Fig. 14) from nearby Weasel Creek contains 1.68 ppm gold. Finally, a stream silt sample (no. 390) from a small tributary to Douglas Creek at the southern border of the WSA is weakly anomalous in zinc (100 ppm).

A stream silt sample (no. 279, Fig. 13) from the West Fork of Indian Creek which drains the southeastern flank of the Hoodoo Mountain WSA (075-151A) is weakly anomalous in lead (41 ppm).

The geochemistry effectively outlines the known mining districts and mineralization in the GRA. The copper skarns, auriferous-sulfide-quartz veins and tetrahedrite veins of the Coloma, Garnet and Top O'Deep districts, as well as associated placer gold deposits are characterized by gold, silver, copper and barite anomalies. Barium values which sometimes exceed



*Data from Campbell et. al, (1982).*

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

**Garnet GRA, Montana**

**Anomalous Geochemical Samples**

| | | |
|---|---|---|
| SCALE 1" = 4 MILES | | FIGURE |
| DATA BY | DATE 3/1983 | 13 |
| DRWN BY DSI | APRVD G.F. | |

## TABLE VIII

## ANOMALOUS GEOCHEMICAL SAMPLES, GARNET GRA, MONTANA

| Sample No. | Type | Au (ppm) | Cu (ppm) | Pb (ppm) | Zn (ppm) | Ag (ppm) | Sb (ppm) | Ba (ppm) |
|---|---|---|---|---|---|---|---|---|
| 9 | RX | 50.0 | | | | | | 100 |
| 10 | " | 3.0 | | | | | | 150 |
| 11 | " | 3.30 | | | | | | 70 |
| 12 | " | 5.70 | | | | | | 20 |
| 13 | " | 21.0 | | | | | | 30 |
| 15 | " | <0.05 | | | | | | 100 |
| 18 | " | .45 | | | | | | 20 |
| 21 | " | 35.0 | | | | | | 20 |
| 22 | " | 167.0 | | | | | | 50 |
| 23 | " | 26.0 | | | | | | 5,000 |
| 24 | " | 29.0 | | | | | | >5,000 |
| 29 | " | .70 | | | | | | 30 |
| 36 | " | 17.0 | >1,000 | 150 | 22 | 14.60 | 85 | 1,500 |
| 37 | " | | 130 | 200 | 30 | 2.19 | 9 | 200 |
| 38 | " | 1.0 | >1,000 | N | 55 | 9.80 | 6 | 20 |
| 40 | " | 60.0 | >1,000 | 17 | 55 | 37.90 | 250 | >5,000 |
| 45 | " | | 500 | 13 | 3 | 2.60 | 34 | 500 |
| 47 | " | | >5,000 | 3,000 | 200 | 20.0 | >1,000 | N |
| 48 | " | | 17 | 7 | 3 | 9.30 | 1 | 200 |
| 51 | " | | 3,000 | 7 | 28 | 3.59 | N | 100 |
| 53 | PC | <0.050 | | | | | | >10,000 |
| 77 | " | N | | | | | | 10,000 |
| 84 | " | <0.050 | | | | | | >10,000 |
| 88 | " | <0.050 | | | | | | >10,000 |
| 95 | " | <0.050 | | | | | | 7,000 |
| 105 | " | N | | | | | | 10,000 |
| 107 | " | N | | | | | | >10,000 |
| 118 | " | 1.920 | | | | | | <50 |
| 119 | " | .630 | | | | | | <50 |
| 120 | " | 5.80 | | | | | | 150 |
| 121 | " | 4.90 | | | | | | 50 |
| 123 | " | 2.250 | | | | | | 200 |

## TABLE VIII (Cont.)

## ANOMALOUS GEOCHEMICAL SAMPLES, GARNET GRA, MONTANA

| Sample No. | Type | Au (ppm) | Cu (ppm) | Pb (ppm) | Zn (ppm) | Ag (ppm) | Sb (ppm) | Ba (ppm) |
|---|---|---|---|---|---|---|---|---|
| 125 | PC | 29.60 | | | | | | 1,000 |
| 127 | " | 5.640 | | | | | | 3,000 |
| 128 | " | .90 | | | | | | 300 |
| 129 | " | .640 | | | | | | 50 |
| 130 | " | 1.00 | | | | | | 70 |
| 133 | " | 1.00 | | | | | | 300 |
| 134 | " | 28.90 | | | | | | 200 |
| 137 | " | 1.680 | | | | | | 300 |
| 138 | " | 1.140 | | | | | | 1,000 |
| 140 | " | 2.40 | | | | | | 500 |
| 141 | " | 46.30 | | | | | | 50 |
| 157 | SS | | 23.0 | 5.0 | 13.0 | 0.05 | 1 | 5,000 |
| 165 | " | | 106.0 | 33.0 | 20.0 | .70 | 1 | 500 |
| 170 | " | | 64.0 | 24.0 | 35.0 | .28 | 1 | 700 |
| 184 | " | | 26.0 | 30.0 | 47.0 | .22 | 5 | 700 |
| 268 | " | | 4 | 5 | 25 | 1.89 | N | 1.5 |
| 269 | " | | 12 | 12 | 12 | 1.42 | 1 | 2.0 |
| 270 | " | | 28 | 28 | 20 | 6.68 | N | 2.0 |
| 271 | " | | 7 | 6 | 3 | 1.44 | N | 1.5 |
| 272 | " | | 5 | 4 | 5 | 2.02 | N | 1.5 |
| 273 | " | | 14 | 9 | 8 | 1.01 | 1 | 1.5 |
| 274 | " | | 13 | 7 | 17 | 1.62 | 1 | 1.5 |
| 275 | " | | 12 | 10 | 9 | 1.21 | 1 | 2.0 |
| 279 | " | | 9 | 4 | <0.05 | .20 | N | 2,000 |
| 288 | " | | 10 | 45 | .20 | .80 | 2 | 1,500 |
| 349 | " | | 18.0 | 117.0 | 33.0 | .10 | 4 | 300 |
| 362 | " | | 60.0 | 19.0 | 11.0 | .16 | 1 | 500 |
| 373 | " | | 19.0 | 65.0 | 55.0 | .10 | 6 | 300 |
| 375 | " | | 22.0 | 52.0 | 103.0 | .11 | 5 | 200 |
| 383 | " | | 59.0 | 54.0 | 28.0 | .28 | 3 | 200 |
| 390 | " | | 9.0 | 28.0 | 100.0 | .13 | 1 | 1,500 |

## TABLE VIII (Cont.)

## ANOMALOUS GEOCHEMICAL SAMPLES, GARNET GRA, MONTANA

Notes:
1. Data from Campbell et al. (1982).
2. Ba spectrographic analysis, all others atomic absorption.
3. Rx = rock, PC = panned concentrate, SS = stream silt.
4. N = not detected, - = not analysed.

10,000 ppm mark barite-bearing veins in the Elk Creek-Coloma district. In addition, downstream from the Baker and Sullivan lead-silver deposit a stream silt sample is moderately anomalous in lead (65 ppm).

Two samples (no. 184, 375; Fig. 6) in the southwest part of the Garnet GRA are anomalous in lead. No mineral occurrences are reported in the area which is underlain by Jefferson Limestone and Madison Group rocks.

The U.S. Department of Energy has conducted a uranium resource evaluation of the Butte Quadrangle, which includes the Garnet GRA, as part of the NURE program (Broxton, 1980; Texas Instruments, Inc., 1979; Van Eeckout, 1980; Salisbury and Dietz, 1982). The uranium-thorium potential of the GRA can be assessed in light of the geologic environment as well as the NURE data. Three ore environments, in about equal amounts, host 90% of the free-world uranium reserves. These are:

1. early Precambrian quartz-pebble conglomerates,
2. sandstone-hosted roll-front deposits, mainly in post carboniferous continental sandstone, and
3. unconformity vein deposits, thus far known only in Proterozoic rocks.

The sandstone-hosted roll front deposits account for about 95% of United States reserves.

In the classical vein deposits, uranium is almost always accompanied by hematite and in the unconformity veins nickel, cobalt, and arsenic may be

present. Sulfides of copper, lead, and molybdenum may occur in either type. Uranium in peneconcordant sandstone deposits is accompanied by iron (as pyrite if the ore is unoxidized) and in many cases by copper, molybdenum, selenium, and vanadium. Sedimentary deposits in Precambrian conglomerates are very large, but also very limited in distribution.

Salisbury and Dietz (1982) concluded that the uranium potential of the Garnet GRA is limited to areas underlain by the Phosphoria Formation and areas within the Douglas Creek basin (Fig. 11). Samples from the phosphatic unit of the Phosphoria Formation are reported to average 0.0102% $U_3O_8$ (Salisbury and Dietz, 1982). Uranium occurs as a substitute for calcium in the carbonate fluorapatite lattice. The carbonate fluorapatite is microcrystalline and forms laminae, pellets, oolites and nodules in the marine phosphorites. The adsorption of uranium is thought to be a syngenetic process that occurs as apatite precipitates on the ocean floor (Jones, 1978). Large tonnages of the phosphorite have been mined for fertilizer from the Garrison mining district just southeast of the GRA. Uranium has not been extracted as a by-product of phosphate mining in Montana. However, it has been extracted in Florida where it is estimated that by-product uranium from marine phosphorite will supply approximately 15% of the projected requirement for the United States in 1980 (Sweeney, 1979). Salisbury and Dietz (1982) classed Douglas Creek Basin (Fig. 11) as a potentially favorable uranium environment because of the presence of Tertiary strata which include arkosic sands, carbonaceous material, and tuffaceous layers. This agrees with the regional assessment of Tertiary basins in western Montana by Thompson et al. (1981). A rock sample from the Basin contains 30 ppm $U_3O_8$. Potential source rocks for uranium in the GRA

are Cretaceous granitic intrusives or volcanic ash and pyroclastics both of which may be interbedded with clastic sediments. The unconsolidated character of the sediments suggests that adequate permeability is present for uranium migration. Precipitants in the form of plant debris are present (Miller, 1980). These factors suggest that the environment is favorable for the operation of roll front mechanisms. While areas of potential uranium favorability occur in the Garnet GRA (Fig. 11), they do not include any part of the WSAs.

No hydrocarbon production is known in the Butte Quadrangle (Cole et al., 1982), however, the recognition of the Cordilleran Thrust Belt as a major hydrocarbon producer in Alberta, Canada and southwestern Wyoming-northeastern Utah (Powers, 1977) and the discovery of commercial gas reserves in the eastern part of the Montana Thrust Belt (McCaslin, 1981b) has increased interest and exploration drilling in western Montana (McCaslin, 1981a). Several tests were drilled southwest of the Garnet GRA including two tests drilled in sec. 33, T.11N., R.13W. and 10 tests drilled in sec. 9, T.10N., R.13W. Data from some of these tests is confidential, and some were abandoned at shallow depths. Most penetrated to depths approaching or exceeding 6,000 feet with one deep test to 18,000 feet. One of these wells reported oil shows. Another test penetrated Precambrian strata to a depth of 5,020 feet, intersected a thrust fault, and passed into Permian strata. This supports the conclusion of Cavanaugh and Cavanaugh (1982a) that the Belt strata are thrust over younger strata and hydrocarbons could be present in traps beneath the thrusts.

Precambrian sediments are shown by Kranzler and Warne (1981) to be potential source beds in the Devil's Fence anticline area 50 miles southeast of the Garnet GRA. Peterson (1981) considers most Mississippian and post-Mississippian strata in western Montana to include potential hydrocarbon source and reservoir beds under the proper structural conditions. Some of the stratigraphic units recognized in the eastern half of the Choteau Quadrangle and characterized as having hydrocarbon source and reservoir bed potential (Mudge et al., 1980) are also recognized in the Garnet GRA. Although these stratigraphic units may be correlative with those in the eastern Choteau Quadrangle they may not possess characteristics favorable for source rocks. Until further studies are conducted on the strata in the Garnet GRA, the dark organic-rich shales may be considered possible source beds, and porous sandstones and carbonate rocks in the Paleozoic and Mesozoic may be considered potential reservoir beds.

The northern one-third of WSA 075-150 is underlain by the Garnet Range pluton, an igneous intrusion. Ruppel et al. (1981) report that the pluton post-dates the Sapphire Thrust; thus, thermal metamorphism associated with the intrusions may have destroyed any hydrocarbons present.

The southern two-thirds of WSA 075-150 and all of WSA 075-151A and B are considered parts of the Garnet Range subplate of the Sapphire thrust plate by Ruppel et al. (1981). The presence of Tertiary igneous plugs and dikes in these areas reduces the potential for hydrocarbons since metamorphism associated with the intrusions could thermally destroy any hydrocarbons present. However, Gwinn (1961) reported the metamorphic aureole around the

intrusions to be limited. This would leave large areas in between intrusions unaltered. It is also possible that hydrocarbon resources exist beneath the surface thrust plates within these areas. The recognition of oil shows in the tests drilled just south of the Garnet GRA and the presence of possible source and reservoir beds in the area suggest hydrocarbons could be present. Geologic structures that could form traps for hydrocarbons are present.

In the most recent geothermal classification of the United States (Muffler, 1979), geothermal resources were divided into six categories. These are:

1. Conduction-dominated regions
2. Igneous-related geothermal systems

3a. High temperature (over 150°C) hydrothermal convection systems
 b. Intermediate temperature (90-150°C) hydrothermal convection systems

4. Low temperature (less than 90°C) hydrothermal convection systems
5. Geo-pressured geothermal energy systems

For the purposes of this study the above classes can be reduced to two: (1) high temperature (over 150°C) hydrothermal convection systems, and (2) low/intermediate temperature (40-150°C) hydrothermal convection systems.

The area of western Montana and Idaho containing the Wilderness Study Areas (WSAs) evaluated during this project can be divided into six provinces of different goethermal significance:

## TABLE IX

## GEOTHERMAL PROVINCES IN GEM REGION 2

1. Montana Thrust/Foothills
2. Montana Basin and Range
3. Central Idaho Basin and Range
4. Idaho Batholith/Blue Mountains
5. Southeastern Idaho Basin and Range
6. Snake River Plains

The Garnet GRA is in the Montana Basin and Range province. Although western Montana is classed physiographically as part of the Northern Rocky Mountains, the Cenozoic (65 m.y. to present) structural geology is similar to the Basin and Range Province of the southwestern United States in that western Montana consists of northnorthwest-trending ranges separated by valleys which are controlled by horst and graben structures. The normal fault systems have been active in the Pliocene (6-2 m.y.)-Pleistocene (Pardee, 1950), and they currently form one of the major seismic zones in the western United States. This zone, the Intermountain Seismic Belt (Smith, 1978), more or less marks the eastern boundary of the Montana Basin and Range province. Typical heat flow values in this province are 75 to 90 milliwatts per square meter (Blackwell, 1969; Blackwell and Robertson, 1973). Typical geothermal gradients range from 15 to 40°C/km and the data are reasonably complete on a reconnaissance basis for this province.

There are numerous hot springs in southwestern Montana. These have been discussed in some detail by Robertson et al. (1976) and are shown on the resource map by Sonderegger and Bergantino (1981). Geochemical reservoir temperatures and measured surface temperatures of these systems generally

indicate maximum temperatures between 75 and 150°C. Typically these hot springs are associated with major fracture zones in granitic plutons or with major fracture/fault zones such as the range-bounding faults (especially when major cross structures intersect these zones). The available data suggest that the likelihood of electrical grade temperature (over 150°C) resources in this province is small. On the other hand, on a relative basis, the low/moderate temperature geothermal resources in the area are significant based on the many known hot and warm springs.

Most geothermal exploitation to the present time has involved areas with surface manifestations. There are, however, geothermal systems which have no surface manifestations and are therefore "blind". An example of this sort of system exists in central Montana in the Marysville mining district (Blackwell et al., 1975; Blackwell and Morgan, 1976) where contact metamorphosed Precambrian Belt Series rocks are underlain by Cretaceous and Cenozoic intrusive rocks. An area of approximately 50 square miles within the younger rocks has a heat flow well above the regional background and at least half that area is underlain by a geothermal system with temperatures of approximately 100°C. The possibility of the existence of such systems is always present and cannot be ruled out without site-specific geothermal exploration data.

The Garnet GRA has several features which favor the occurrence of geothermal resources (Williams, 1975). The GRA is located in the Cordilleran Thermal Anomaly Zone which has an average heat flow of 2.2 microcalories per square centimeter per second (Blackwell, 1969; Blackwell and Robertson, 1973). There are extensive relatively young (Eocene) volcanic rocks in the area

(Chadwick, 1981). Alt et al. (1971) suggest, on the basis of geomorphic evidence, that some of the volcanism in the area may be as young as Pleistocene. The GRA is adjacent to the structural zone defined by the Montana lineament (Wiedman, 1965, 1982). Finally there are several warm springs in the area (Fig. 8).

There are no heat flow or geothermal gradient data available from within or near the Garnet GRA. In western Montana, hot springs are much less common north of the Clark Fork River, the southern boundary of the Garnet GRA (Robertson et al., 1976; Sonderegger and Bergantino, 1981). Two warm springs occur at the south edge of the GRA in the Bearmouth area as described previously (Williams, 1975) and several warm springs also occur on Wales Creek within the WSA in sec. 12, T.13N., R.13W. but their exact location is not known. The spring temperatures at Bearmouth are 23 and 17°C respectively and estimated reservoir temperatures are 50-60°C for all geochemical geothermometers (Table V). These two warm springs and another near Garrison, Montana (with a temperature of 25°C) are associated with exposures of Madison Group limestones (Mississippian) on the north limb of a synclinorium (Williams, 1975; Chadwick and Leonard, 1978). Williams (1975) concludes that circulation of meteoric waters to a depth of 0.6-1.25 miles (1-2 km) could produce the observed surface temperatures. His study further indicates a magmatic heat source is not present at Bearmouth.

The geothermal potential within the WSAs is much lower than elsewhere in the Garnet GRA. The elevations in the WSAs are generally high; thus, they are hydrologic recharge areas if the rocks are permeable. In addition, the WSAs are not underlain by the Madison limestones and it is unlikely that they are

connected with the flow systems in the warm springs in the Bearmouth area. Although the heat flow may be high, the rocks have high thermal conductivities and the geothermal gradients, if conductive, will be relatively low (1.2-2.0°F/100 ft.). A very low but definite possibility exists in both WSAs for the occurrence of a Marysville-type system.

The Wales Creek WSA may be an exception to the foregoing discussion. The reservoir for the Wales Creek springs appears to be in Late Cretaceous intrusive rocks. The emphasis of the mapping by Burlington Northern was apparently in the Tertiary volcanic rocks (Mindy Mason pers. comm., 1982); therefore, it is possible that the geothermal activity is related to Tertiary volcanism. Much of the Wales Creek WSA is underlain by intrusive rocks which suggests some geothermal potential for the area, but data on the occurrences is very limited.

## 3.5 Mineral and Energy Economics

Prior to 1960, mines in the Garnet and Coloma mining districts produced 130,595 ounces of gold; 123,912 ounces of silver; 180,202 pounds of copper; 26,298 pounds of lead; and 2,544 pounds of zinc. In addition as of 1968 mines in Powell County, which includes much of the Garnet GRA but not the Garnet or Coloma districts, had produced 61,851 ounces of gold, 1,348,003 ounces of silver, 825,408 pounds of copper, 5,064,067 pounds of lead and 950,947 pounds of zinc (McClernan, 1976). The region is one of the most highly mineralized areas in the world (Elliot, oral comm., 1982) and is being actively explored by mining companies and prospectors today. The area

has excellent access provided by numerous primary and secondary roads. Water is plentiful. The nearby mining towns of Philipsburg and Butte represent a pool of experienced labor, and a custom mill operates in Philipsburg. The data reviewed in the previous sections suggests that the greatest potential for resources is for lode and placer gold deposits, copper-gold-silver lode deposits and limestone.

The rise in the price of gold in the past decade has spurred massive exploration efforts and led to the development of many deposits which were previously uneconomic. It is forecast that domestic mine production will supply only about one-third of United States demand for primary gold through the year 2000, with about two-thirds of mined gold coming from gold deposits and the remainder produced as by-products of base metal mining (Butterman, 1980). The consequent demand for gold and present high price levels make development of domestic gold deposits attractive. Modern heavy equipment has lead to a reduction in placer mining costs and resultant revival of old placer districts in many parts of the United States. Placer mining is currently taking place in Deep Creek just south of WSA 075-150. Many fine-grained or low grade gold ores which are not amenable or economical to process through a conventional mill can now be processed by cyanide heap-leaching. This process is used to recover gold and silver from ores assaying 0.03 to 0.09 ounces of gold per ton and involves spraying dilute cyanide solutions over crushed ore on impervious pads. The pregnant solutions are recovered after percolating through the ore heap and the precious metals are recovered from the solutions using carbon-absorption or zinc dust precipitation (Elevatorski, 1981). The world's largest heap-leaching operation is in northcentral Montana within the Little Rocky

Mountains where 65,000 ounces of gold and 140,000 ounces of silver are produced annually from 3.8 million tons of ore averaging 0.033 ounces of gold per ton and 0.285 ounces of silver per ton (Rogers and Enders, 1982).

The price of silver has also increased dramatically in recent years and the United States currently imports over 50% of its silver. Current import levels are expected to continue if future supply-demand relationships follow present trends (Drake, 1980; Rosta, 1982). A lode silver mine, the Black Pine Mine owned by Inspiration Development Company, is in operation 8 miles south of the Garnet GRA. The mine produces silver from a 5-10 foot thick concordant vein. The ore averages 5.59 oz/t silver and 0.6% copper (Silva, pers. comm., 1982). Mining is at a rate of 1,000 to 1,200 tons per day by room and pillar method using trackless equipment. Previously the ore was shipped directly to the ASARCO smelter in Helena. In 1981 a custom mill opened in Philipsburg contributing to a lowering of operating costs and increased production. Presumably, ore from any silver deposits found in the Garnet GRA could also be milled at Philipsburg.

Limestone was mined prior to 1978 just east of Rattler Gulch. It was used for sugar beet refining and as a smelter flux, but those markets have since collapsed (Williams pers comm., 1982). Limestone and dolomite have a variety of other uses including aggregate, cement, lime, building stone, fluxes, glass raw material, refractories fillers, abrasives, soil conditioners and many others (Chelini, 1965). The generally low unit value of most limestone and dolomite dicates that production and transportation cost be low (Carr and Rooney, 1975). In this light distance to market is a major factor and the relatively developed character of the GRA and the short

distance to major population centers make transportation costs relatively low should new markets develop in these population centers. High calcium limestone ( 95% $CaCO_3$) and high purity dolomite ( 40% $MgCO_3$) which have a variety of uses in the chemical and metallurgical industries are less common and hence have a higher unit value than common grades of limestone and dolomite (Hubbard and Erickson, 1973). Thus, it is possible to ship high calcium limestone and high purity dolomite a greater distance than common varieties of limestone and dolomite.

Based on present requirements for use of hot fluids in electrical generating techniques, geothermal systems with temperatures of less than 150°C do not have significant potential for electrical exploitation. These systems, however, can have a significant potential for low and intermediate temperature geothermal utilization for space heating, material processing, etc. if their minimum temperature exceeds 40°C. At the lower end of the spectrum, as the energy content of the resource becomes less, or the drilling depth necessary for exploitation becomes greater, there is a very ill-defined cutoff. For example, shallow ground water temperatures on the order of 10-20°C can be used for heat pump applications, and in some cases these are considered geothermal resources. However, for the purpose of this evaluation, a lower temperature than approximately 40-60°C is considered an economic cutoff for a geothermal resource. Another important economic factor affecting the viability of a geothermal resource is the distance from the source to the point of consumption. At lower temperatures it is not feasible to consider long-distance transportation of geothermal energy whereas for electrical grade resources long transportation distances are of course feasible. Of course many of the warm springs in the western United States have been used for recreational purposes regardless of location.

## 4.0 LAND CLASSIFICATION FOR GEM RESOURCES POTENTIAL

### 4.1 Explanation of Classification Scheme

In the following section the lands in the Wales Creek WSA 075-150, Hoodoo Mountain 075-151A and Gallagher Creek 075-151B WSAs are classified for geology, energy and mineral (GEM) resources potential. The classification scheme used is shown in Table X. Use of this scheme is specified in the contract under which WGM prepared this report.

The evaluation of resource potential and integration into the BLM classification scheme has been done using a combination of simple subjective and complex subjective approaches (Singer and Mosier, 1981) to regional resource assessment. The simple subjective approach involves the evaluation of resources based on the experience and knowledge of the individuals conducting the evaluations. The complex subjective method involves use of rules, i.e. geologic inference, based on expert opinion concerning the nature and importance geologic relationships associated with mineral and energy deposits (Singer and Mosier, 1981).

The GEM resource evaluation is the culmination of a series of tasks. The nature and order of the tasks was specified by the BLM, however they constitute the general approach by which most resource evaluations of this type are conducted. The sequence of work was: (1) data collection, (2) compilation, (3) evaluation, and (4) report preparation. One day of field work was conducted at the head of Deep Creek and in Bilk Gulch in the Wales Creek WSA by WGM personnel (Appendix III).

## TABLE X

## BUREAU OF LAND MANAGEMENT GEM RESOURCES LAND CLASSIFICATION SYSTEM

### CLASSIFICATION SCHEME

1. The geologic environment and the inferred geologic processes do not indicate favorability for accumulation of mineral resources.
2. The geologic environment and the inferred geologic processes indicate low favorability for accumulation of mineral resources.
3. The geologic environment, the inferred geologic processes, and the reported mineral occurrences indicate moderate favorability for accumulation of mineral resources.
4. The geologic environment, the inferred geologic processes, the reported mineral occurrences, and the known mines or deposits indicate high favorability for accumulation of mineral resources.

### LEVELS OF CONFIDENCE

A. The available data are either insufficient and/or cannot be considered as direct evidence to support or refute the possible existence of mineral resources within the respective area.

B. The available data provide indirect evidence to support or refute the possible existence of mineral resources.

C. The available data provide direct evidence, but are quantitatively minimal to support or refute the possible existence of mineral resources.

D. The available data provide abundant direct and indirect evidence to support or refute the possible existence of mineral resources.

## 4.2 Classification of the Wales Creek (075-150) Wilderness Study Area

### 4.2.1 Locatable Minerals

Locatable minerals are those which are locatable under the General Mining Law of 1872, as amended, and the Placer Act of 1870, as amended. Minerals which are locatable under these acts include metals, ores of metals, nonmetallic minerals such as asbestos, barite, zeolites, graphite, uncommon varieties of sand, gravel, building stone, limestone, dolomite, pumice, pumitice, clay, magnesite, silica sand, etc. (Maley, 1983).

4.2.1a Metallic Minerals. The southwest corner of WSA 075-150, the Top O'Deep area, and the Your Name Creek Basin (Area 1a, Fig. 4) are classified as highly favorable for the occurrence of metallic minerals based on direct evidence (4D), specifically placer gold deposits, precious metal-bearing quartz veins in intrusive and sedimentary rocks, and base and precious metal-bearing skarn deposits. The classification is based on the geologic environment and the presence of mines with significant historic metal production. In addition, the highly anomalous gold values in panned concentrate samples from Weasal Creek and Bilk Gulch indicate significant placer gold accumulations and possibly a lode source within the drainage basins upstream from the sample location. The remainder of the WSA (Area 2a, Fig. 14) is classified moderately favorable based on limited direct evidence (3C) including the presence of a geologic setting similar to known metal deposits and occurrences in the immediately adjacent areas of the Garnet GRA.

## Garnet GRA, Montana
## Legend For Figure 14

### *BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES*

#### CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

#### LEVELS OF CONFIDENCE

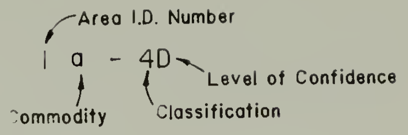
A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

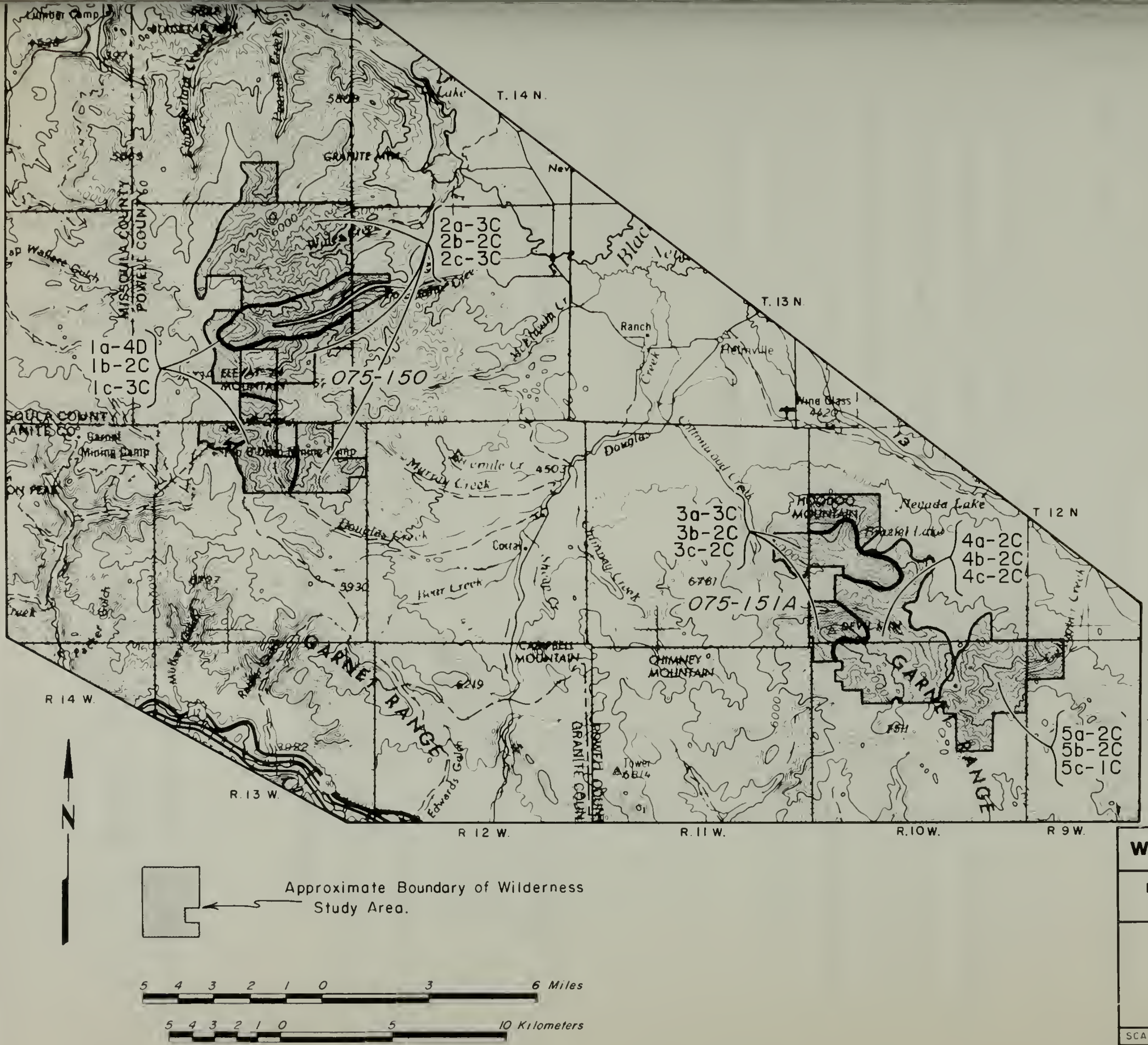
C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

#### EXPLANATION



a) Metallic Minerals
b) Uranium and Thorium
c) Non-Metallic Minerals



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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

***Garnet GRA, Montana***
*Wilderness Study Area*
*Land Classification*
*Locatable Resources*

| | | | |
|---|---|---|---|
| SCALE 1":4 MILES (1 250,000) | | | FIGURE |
| DATA BY WGM | DATE 9/1982 | REVISED | 14 |
| DRWN BY DSI | APRVD GF | | |

4.2.1b Uranium and Thorium. All of WSA 075-150 (Area 1b and 2b, Fig. 14) is classifed as having low favorability for the occurrence of uranium and thorium based on limited direct evidence (2C). The basis of this classification is the absence of both geochemical and radiometric anomalies in the NURE data for the area and the generally unfavorable geologic environment.

4.2.1c Non-Metallic Minerals. WSA 075-150 (Area 1c and 2c, Fig. 14) is classified as having moderate favorability for barite and uncommon varieties of limestone based on limited direct evidence (3C). This classification is based on the occurrence of vein barite in the region and the strong barium geochemical anomalies in the WSA and adjacent drainages. The southern half of the WSA is underlain by Paleozoic carbonate rocks which are known to contain high calcium limestone within the Garnet GRA.

### 4.2.2 Leasable Resources

Leasable resources include those which may be acquired under the Mineral Leasing Act of 1920 as amended by the Acts of 1927, 1953, 1970, and 1976. Materials covered under this Act include: asphalt, bitumen, borates and sodium and potassium, carbonates of sodium and potassium, coal, natural gas, nitrates of sodium and potassium, oil, oil shale, phosphate, silicates of sodium and potassium, sulfates of sodium and potassium, geothermal resources, etc. (Maley, 1983).

4.2.2a Oil and Gas. WSA 075-150 (1a, Fig. 15) is classified as having low favorability for oil and gas based on limited direct evidence (2C). The

# Garnet GRA, Montana
# Legend For Figure 15

## BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

### CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

### LEVELS OF CONFIDENCE

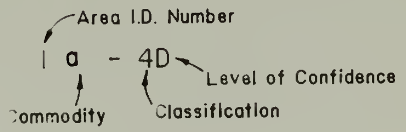
A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

### EXPLANATION

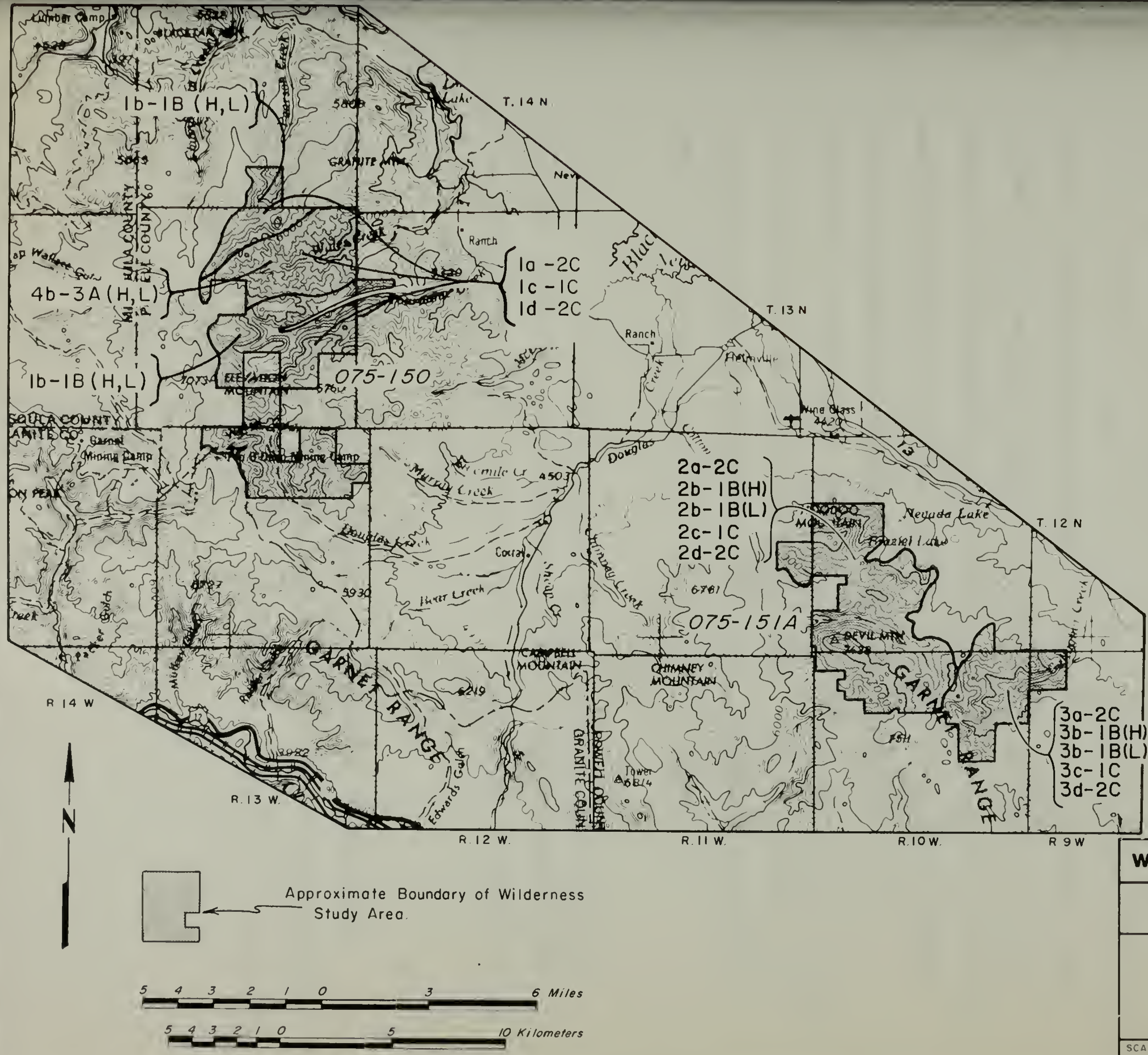


a) oil and gas

b) Geothermal: high temperature (H), Low temperature (L)

c) Sodium and Potassium

d) others: Asphalt (As) bitumen (bt), phosphate (ph), No specific commodity designation indicates that the rating applies to all of the above.



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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

## *Garnet GRA, Montana*

*Wilderness Study Area*
*Land Classification*
*Leasable Resources*

SCALE 1": 4 MILES (1 250,000)
DATA BY WGM | DATE 9/1982
DRWN BY DSI | APRVD GF

FIGURE
15

classification is based on the generally unfavorable geologic setting of the WSA as compared with known hydrocarbon producing areas in the "overthrust belt". Most of the WSA is underlain by igneous terrane.

4.2.2b. Geothermal. The portion of WSA 075-150 which is underlain by sedimentary rocks (1b, Fig. 15) is classified as having low favorability for geothermal resources based on indirect evidence (2B). This classification is based on the geologic, topographic and hydrologic setting of the WSA as compared with known geothermal areas in the region. The portion of the WSA underlain by plutonic rocks (4b, Fig. 15) is classified as having moderate potential for geothermal resources; however, the available data is insufficient for a definitive evaluation (3A). This classification is based on the presence of warm springs on Wales Creek. The low confidence rating is assigned because of the lack of available data on the exact location, temperature, geochemistry, and geological setting of the springs.

4.2.2c Sodium and Potassium. WSA 075-150 (1c, Fig. 15) is classified as having low favorability for sodium and potassium based on limited direct evidence (2C). The classification is based on the unfavorable nature of the geologic environment in the WSA.

4.2.2d Other. WSA 075-150 (1d, Fig. 15) is classified as having low favorability for other leasable resources based on limited direct evidence (2C). This includes phosphate since the Phosphoria Formation is not present in the WSA.

### 4.2.3 Saleable Resources

Saleable resources include those which may be acquired under the Materials Act of 1947 as amended by the Acts of 1955 and 1962. Included under this Act are common varieties of sand, gravel, stone, cinders, pumice, pumicite, clay, limestone, dolomite, peat and petrified wood (Maley, 1983).

The portion of WSA 075-150 (2, Fig. 16) underlain by carbonate rocks is classified as moderately favorable for common varieties of limestone based on limited direct evidence (3C). The rest of WSA 075-150 (1, Fig. 16) is classified as having low favorability for saleable resources based on limited direct evidence (2C).

## 4.3 Classification of the Hoodoo Mountain (075-151A) Wilderness Study Area

### 4.3.1 Locatable Minerals

Locatable minerals are those which are locatable under the General Mining Law of 1872, as amended, and the Placer Act of 1870, as amended. Minerals which are locatable under these acts include metals, ores of metals, nonmetallic minerals such as asbestos, barite, zeolites, graphite, uncommon varieties of sand, gravel, building stone, limestone, dolomite, pumice, pumitice, clay, magnesite, silica sand, etc. (Maley, 1983).

4.3.1a Metallic Minerals. Those portions of the WSA 075-151A underlain by Paleozoic or Precambrian strata (3a, Fig. 14) are classified as having moderate favorability for metallic minerals based on limited direct evidence

# Garnet GRA, Montana
# Legend For Figure 16

## *BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES*

### CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

### LEVELS OF CONFIDENCE

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

### EXPLANATION

Area I.D. Number

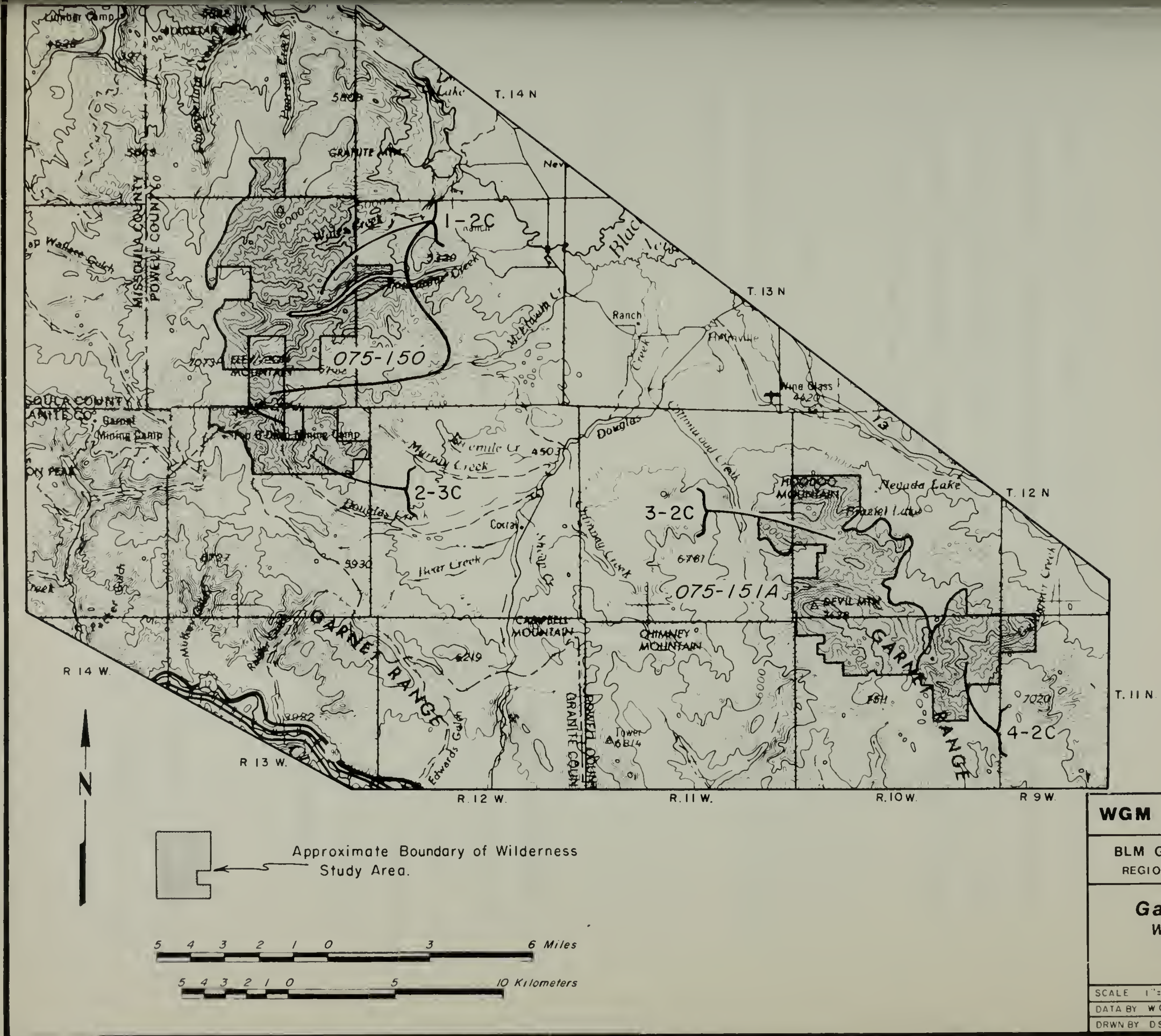
1(1s) - 4D

Level of Confidence

Commodity

Classification

| | |
|---|---|
| s | Sand |
| g | Gravel |
| st | Stone |
| c | Cinders |
| p | Pumice |
| pt | Pumicite |
| cl | Clay |
| Ls | Limestone |
| dl | Dolomite |
| P | Peat |
| pw | Petrified wood |



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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

**Garnet GRA, Montana**
*Wilderness Study Area*
*Land Classification*
*Saleable Resources*

| | | |
|---|---|---|
| SCALE 1"=4 MILES (1 250,000) | | FIGURE |
| DATA BY WGM | DATE 9/1982 | 16 |
| DRWN BY DSI | APRVD G F | |

(3C). The geological setting of the WSA is similar to the metal producing regions in the western part of the Garnet GRA. The remainder of the WSA (4a, Fig. 14) is classified as having low favorability for metallic minerals based on indirect evidence (2C).

4.3.1b Uranium and Thorium. WSA 075-151A (3b and 4b, Fig. 14) is classified as having low favorability for uranium and thorium based on limited direct evidence (2C). The basis of this classification is the presence of unfavorable Paleozoic to Precambrian marine sedimentary host rocks and wide expanses of Tertiary volcanic rocks.

4.3.1c Non-Metallic Minerals. All of WSA 075-151A (3c and 4c, Fig. 14) is classified as having low favorability for locatable non-metallic resources baed on limited direct evidence (2C).

### 4.3.2 Leasable Resources

Leasable resources include those which may be acquired under the Mineral Leasing Act of 1920 as amended by the Acts of 1927, 1953, 1970, and 1976. Materials covered under this Act include: asphalt, bitumen, borates and sodium and potassium, carbonates of sodium and potassium, coal, natural gas, nitrates of sodium and potassium, oil, oil shale, phosphate, silicates of sodium and potassium, sulfates of sodium and potassium, geothermal resources, etc. (Maley, 1983).

4.3.2a Oil and Gas. WSA 075-151A (2a, Fig. 15) is classified as having low favorability for oil and gas based on limited direct evidence (2C). The

classification is based on the generally unfavorable geologic setting of the WSA as compared with known hydrocarbon producing areas in the "overthrust belt" and on the data and discussion in section 3.4.

4.3.2b Geothermal. WSA 075-151A (2b, Fig. 15) is classified as unfavorable for both low and high temperature geothermal resources based on direct evidence (1B). The basis of the classification is the geologic, topographic and hydrologic setting of the WSA as compared to known geothermal occurrences in the region.

4.3.2c Sodium and Potassium. WSA 075-151A (2c, Fig. 15) is classifed as having low favorability for sodium and potassium based on limited direct evidence (2C). The classification is based on the generally unfavorable nature of the geologic environment in the WSA.

4.3.2d Other. WSA 075-151A (2d, Fig. 15) is classified as having low favorability for other leasable resources based on limited direct evidence (2C). This includes phosphate since the Phosphoria Formation is not present in the WSA.

### 4.3.3 Saleable Resources

Saleable resources include those which may be acquired under the Materials Act of 1947 as amended by the Acts of 1955 and 1962. Included under thie Act are common varieties of sand, gravel, stone, cinders, pumice, pumicite, clay, limestone, dolomite, peat and petrified wood (Maley, 1983).

WSA 075-151A (3, Fig. 16) is classified as having low favorability for saleable resources based on limited direct evidence (2C).

## 4.4 Classification of the Gallagher Creek (075-151B) Wilderness Study Area

### 4.4.1 Locatable Minerals

Locatable minerals are those which are locatable under the General Mining Law of 1872, as amended, and the Placer Act of 1870, as amended. Minerals which are locatable under these acts include metals, ore metals, nonmetallic minerals such as asbestos, barite, zeolites, graphite, uncommon varieties of sand, gravel, building stone, limestone, dolomite, pumice, pumitice, clay, magnesite, silica sand, etc. (Maley, 1983).

4.4.1a Metallic Minerals. All of WSA 075-151B (5a, Fig. 14) is classified as having low favorability for metallic minerals based on limited direct evidence (2C). The geologic setting is not particularly favorable and there are no known occurrences or geochemical anomalies in the immediately surrounding area.

4.4.1b Uranium and Thorium. All of WSA 075-151B (5b, Fig. 14) is classified as having low favorability for uranium and thorium based on limited direct evidence (2C). The classification is based on the volcanic character of the bedrock and the absence of geochemical and radiometric anomalies in the area.

4.4.1c Non-Metallic Minerals. WSA 075-151B (5c, Fig. 14) is classified as unfavorable for non-metallic minerals based on limited direct evidence (1C). The geological setting is generally not favorable.

### 4.4.2 Leasable Resources

Leasable resources include those which may be acquired under the Mineral Leasing Act of 1920 as amended by the Acts of 1927, 1953, 1970, and 1976. Materials covered under this Act include: asphalt, bitumen, borates and sodium and potassium, carbonates of sodium and potassium, coal, natural gas, nitrates of sodium and potassium, oil, oil shale, phosphate, silicates of sodium and potassium, sulfates of sodium and potassium, geothermal resources, etc. (Maley, 1983).

4.4.2a Oil and Gas. WSA 075-151B (3a, Fig. 15) is classified as having low potential for oil and gas based on limited direct evidence (2C). The classification is based on the geologic setting of the WSA as compared with known hydrocarbon producing areas in the "overthrust belt" and on the data and discussion in section 3.4.

4.4.2b Geothermal. WSA 075-151B (3b, Fig. 15) is classified as unfavorable for both low and high temperature geothermal resources based on indirect evidence (1B). The geologic and topographic setting of the WSA compared to known geothermal areas in the region is unfavorable.

4.4.2c Sodium and Potassium. All of WSA 075-151B (3c, Fig. 15) is classified as having low favorability for sodium and potassium based on

limited direct evidence (2C). The classification is based on the nature of the geologic environment in the WSA.

4.4.2d Other. All of WSA 075-151B (3d, Fig. 15) is classified as unfavorable for other leasable resources based on limited direct evidence (1C). This includes phosphate since the Phosphoria Formation is not present in the WSA.

### 4.2.3 Saleable Resources

Saleable resources include those which may be acquired under the Materials Act of 1947 as amended by the Acts of 1955 and 1962. Included under this Act are common varieties of sand, gravel, stone, cinders, pumice, pumicite, clay, limestone, dolomite, peat and petrified wood (Maley, 1983).

WSA 075-151B (4, Fig. 16) is classified as having low favorability for saleable resources based on limited direct evidence (2C).

## 5.0 RECOMMENDATIONS FOR FURTHER WORK

The highly anomalous gold values from panned concentrate samples collected by the U.S. Geological Survey in the Top O'Deep area (WSA 075-150) should be resampled in order to confirm the anomalies. Neighboring drainages should also be sampled at close-spaced intervals to ascertain the areal extent of the gold anomaly and to pinpoint its source area. Pending favorable results. the drainage basin(s) should be geologically mapped 1:12,000 scale and favorable lithologies should be sampled in order to identify possible lode resources.

Detailed geologic examination should be conducted in the Your Name Creek drainage (WSA 075-150) to determine the extent and tenor of gold-bearing gravels. The Blue Bird prospect and surrounding areas should be definitively examined to confirm the presence and understand the nature of the deposit.

Although numerous geochemical samples have been collected in the area by the U.S. Geological Survey comparatively few have been collected from the northern two-thirds of WSA 075-150 and in WSA 075-151A. Stream sediment and corresponding panned concentrate samples should be collected in these two WSAs at a minimum density of two sites per square mile.

The Garnet pluton should be detailed mapped (1:24,000 scale) in order to identify any differentiation present. Differentiated plutons and those with multiple intrusive episodes are favorable for a variety of metallic mineral deposits.

Three recommendations are made in order to perform a thorough evaluation of the hydrocarbon potential of the WSAs:

1. Potential hydrocarbon source and reservoir beds present in the WSAs should be evaluated in detail.

2. Thermal maturation studies should be made in the Garnet Range region. This will indicate the degree of alteration of hydrocarbon resources in the area and determine the type of hydrocarbons to be expected in the area.

3. Seismic studies should be conducted throughout the area. These studies would permit interpretation of subsurface structures and their relationship to surface structures. They will also help locate favorable drilling sites. Such studies may already exist in petroleum company files for part of the area.

Geothermal evaluation of the WSAs should initially involve geochemical studies. In the Wales Creek WSA (075-150), mining activity might have resulted in drilling of exploration holes which could be used for geothermal gradient studies. Finally, the BLM should try to obtain Burlington Northern's data from the Wales Creek area. Depending on the quality and detail of the data, the ranking or level of confidence of the geothermal classification might be upgraded.

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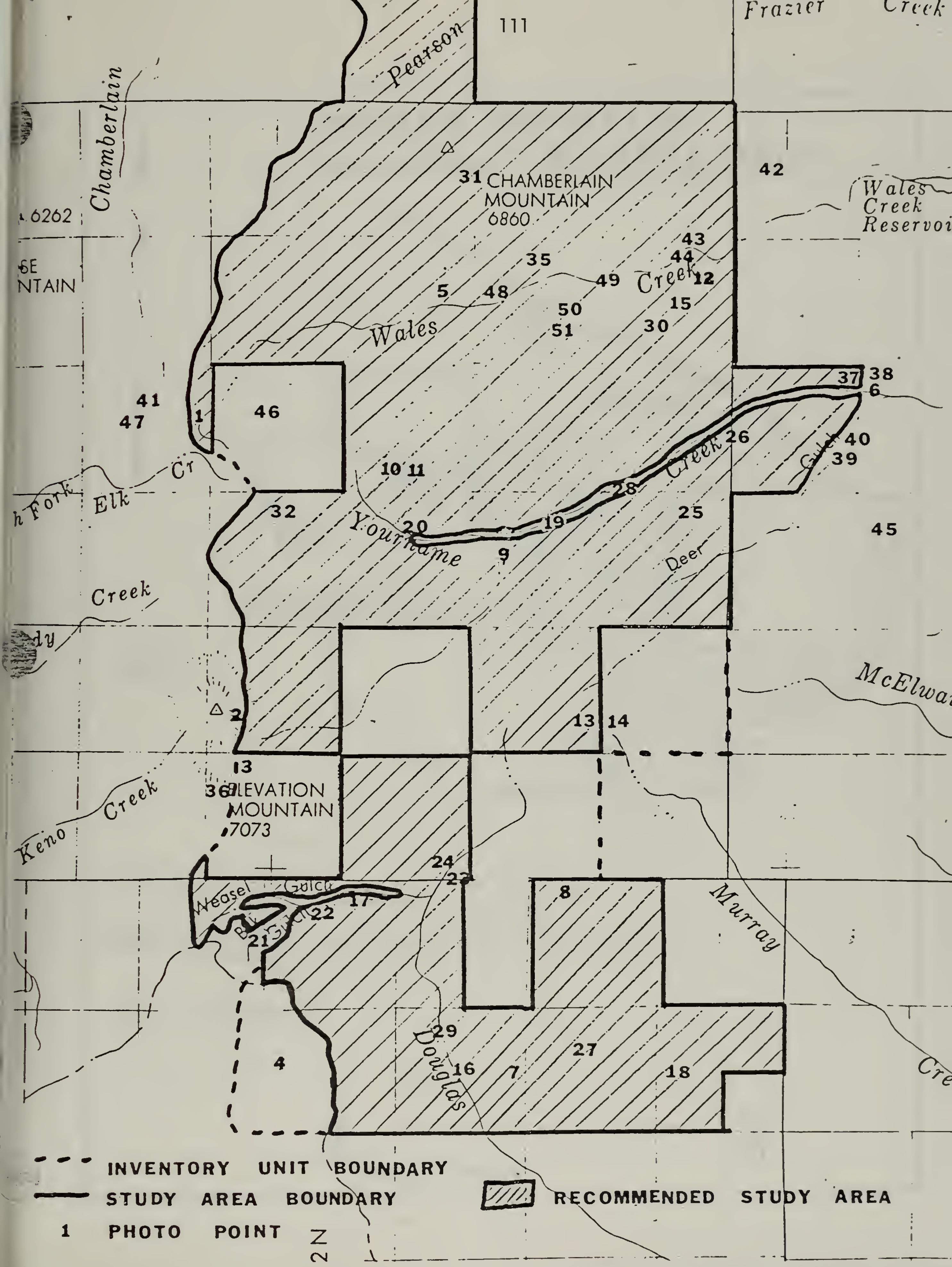
# APPENDIX I

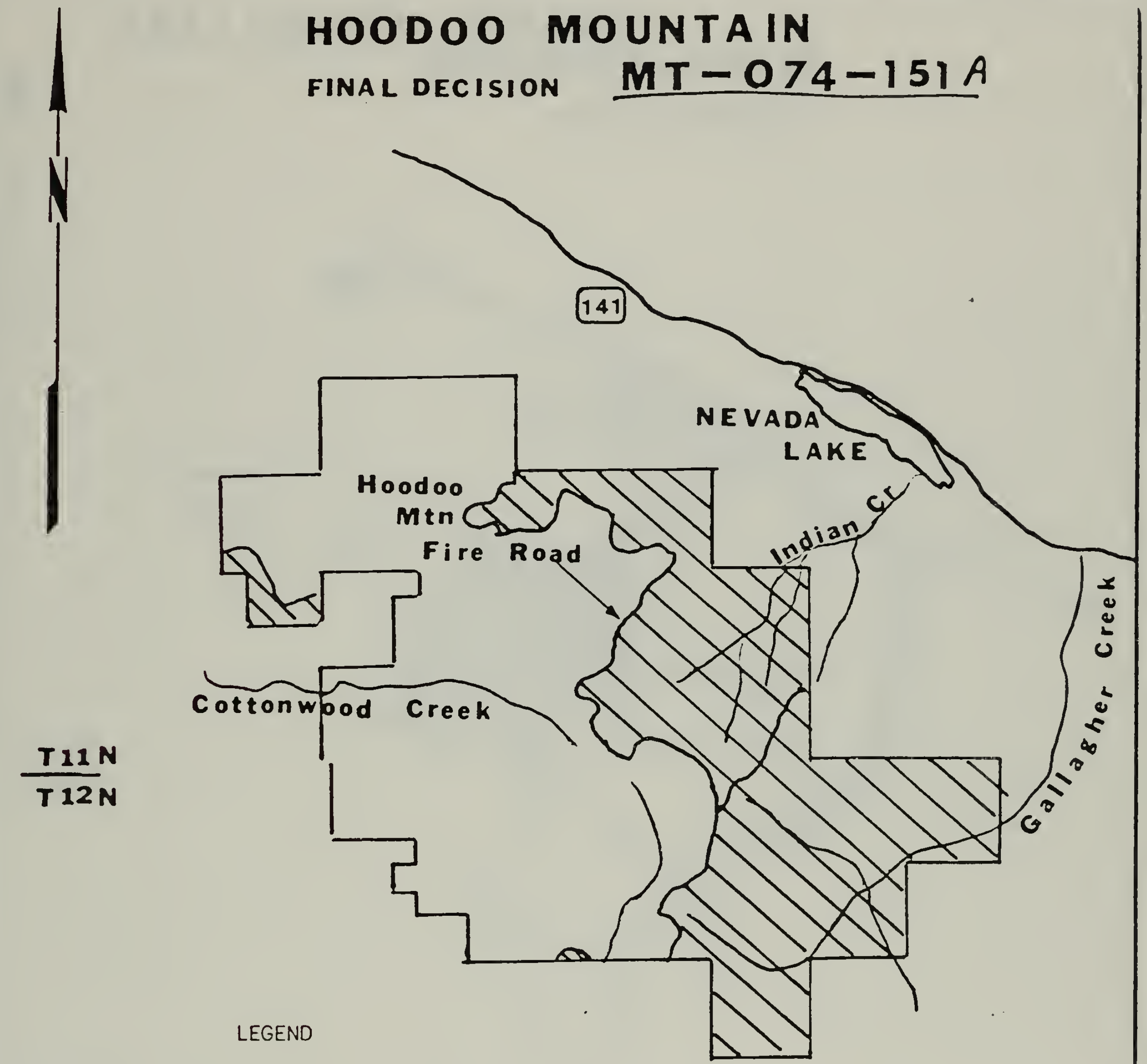
## Wilderness Study Area Maps



WALES CREEK WSA, 075-15

# HOODOO MOUNTAIN

FINAL DECISION **MT-074-151A**



LEGEND

▱ Unit or portion of unit possessing wilderness characteristics (recommended as a W.S.A.).

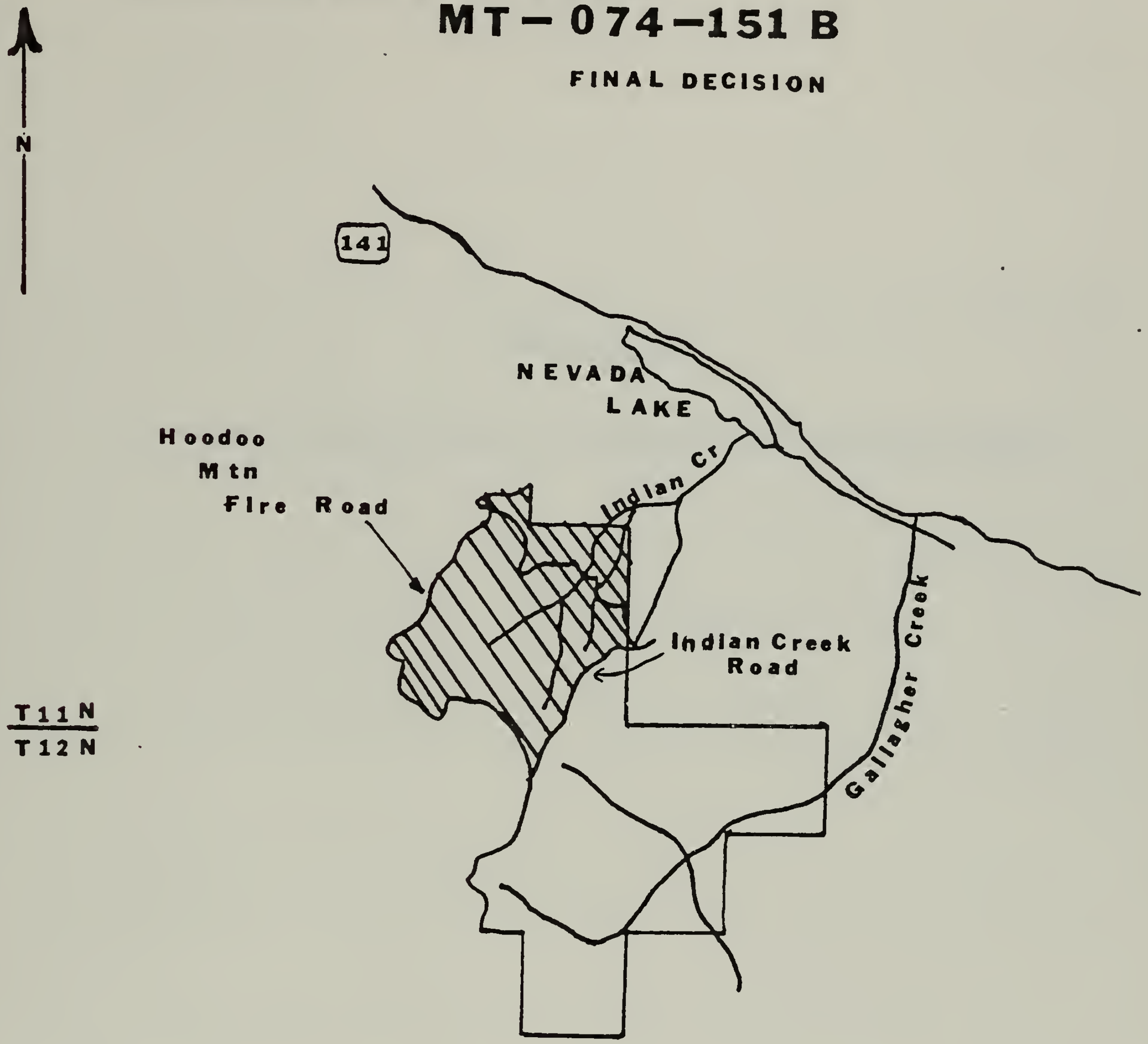
▨ Unit or portion of unit lacking wilderness characteristics (not recommended as a W.S.A.).

▭ State Highway

Scale 1:100,000

# GALLAGHER CREEK
## MT-074-151 B

FINAL DECISION



LEGEND

▱ Unit or portion of unit possessing wilderness characteristics (recommended as a W.S.A.).

▨ Unit or portion of unit lacking wilderness characteristics (not recommended as a W.S.A.).

▢ State Highway

**Scale 1:100,000**

R 10 W | 9 W

# APPENDIX II

Notes from discussion with C.A. Wallace, U.S. Geological Survey

# Memo

To: Garnet GRA File
Fm: Greg Fernette

Subject: Telephone Conversation with Chet Wallace, USGS

The notes below were taken on September 28, 1982 during a phone conversation with C.A. Wallace of the U.S. Geological Survey. Wallace mapped the Garnet GRA in 1974-75.

They haven't published any new information on structure and stratigraphy in the area since their paper in the 1981 MGS Guidebook. Consequently, there are no detailed descriptions from the newer geologic mapping in the area. Wallace said that the descriptions of the Paleozoic and Mesozoic rocks given by Kauffman are very accurate. Gwinn's description of the Mesozoic rocks are also good. They've made some changes in the Mesozoic stratigraphy. The Dunkleburg Formation has been changed to the lower part of the Blackleaf and there is very little Taft Hill Formation. They have revised the structure considerably from Gwinn. Gwinn's east dipping thrusts are eliminated as most were found to dip to the west. Some of the thrusts are listric but most are flat. There are a few east dipping structures but these are mainly back faults. Gwinn believed that the east dipping structures were related to the Boulder Batholith but Wallace believes they're related to the Saphire Plate.

The Garnet Stock is largely uniform in the west part. It is mostly granodiorite but Wallace found some monzogranite at the head of Wales Creek suggesting that the stock is differentiated. He didn't see any evidence of multiple intrusion but the outcrop is poor and his mapping in Wales Creek is only fair.

There is skarn present at the contact of the Garnet Stock almost wherever it has contact with Paleozoic rocks. The Silver Hill and Jefferson Formations are particularly favorable. The contact is not too well exposed in the Top O'Deep area. There is an isolated body of granodiorite, possibly a satellite of the Garnet Stock, and numerous small dikes in the Top O'Deep area. Wallace believes that the gold mineralization at Top O'Deep is similar to that at Garnet.

# APPENDIX III

## Report on Field Visit to the Wales Creek WSA

# Memo

To: Garnet GRA File
Fm: Greg Fernette, Bill Jones

Subject: Field Visit to Wales Creek WSA, October 6, 1982

As per the plans made in the September progress meeting, we visited the southern end of the Wales Creek WSA. The purpose of the visit was to (a) examine the area as the possible source of the placer gold in Deep Creek, (b) to check for skarns associated with the satellite of the Garnet Stock.

We spent the day of October 6 around the south boundary of the WSA at the head of Deep Creek and Bilk Gulch. The small body of granodiorite was found to extend further east than is shown on the published geologic map (OFR 81-1013), and the contact is within the WSA. We found skarn intermittently all along the contact down Bilk Gulch. The skarn was mainly fine-grained garnet-epidote-diopside. Veins of coarse specular hematite were found in float and copper stain; chrysocolla, was present locally.

We also examined two old mines; the Pearl mine and the Hartford prospect. The Pearl mine is a caved shaft driven along faults in granodiorite. There is an inlier of white sucrosic limestone just to the north of the mine, and the granodiorite-limestone contact is located just to the south. The fault and associated quartz veins exposed in the shaft trend N50E, and dip 75E. The granodiorite in the zone is altered. The zone is 6-8 feet wide and is truncated on the south by a fault trending S15W, dip 60W. Extensive caved workings extend to the northeast parallel to the stock contact. We found only a few pieces of skarn and some malachite stain.

The Hartford prospect is a zone of garnet skarn in granodiorite. The zone is about 40 feet wide, and trends N45-50W, dip 87 east. It extends for over 500 feet to the northeast into the WSA where vegetation covers the outcrop and talus. The zone consists of coarse red garnet, specular hematite and epidote. The granodiorite for several fee adjacent to the skarn is strongly sericitized and has numerous thin quartz veinlets. Malachite stain is common, as is hematite but no copper sulfides were seen.

There is a second skarn zone located about 150 feet north of the main zone.

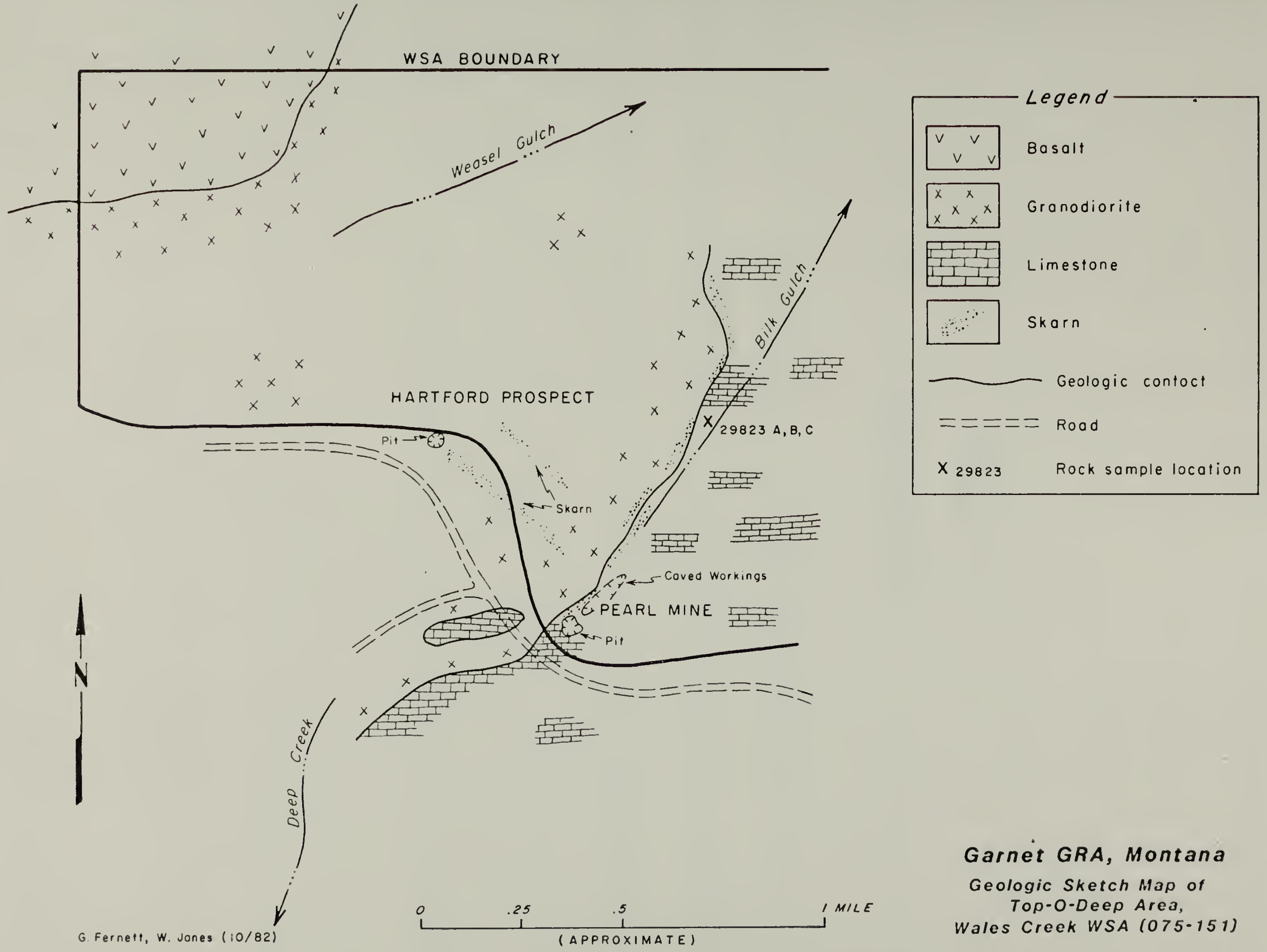
The two skarn zones appear to be along structures cutting the granodiroite. The zones extend to the northeast into the WSA.

A number of rock samples were collected in the area. Three were chosen for geochemical analysis. All three are grab samples of float from Bilk Gulch and were collected in the WSA. Sample descriptions and analytical data are listed below.

Field Visit to Wales Creek GRA,
October 6, 1982
Page -2-

| Sample No. | Description | Cu (ppm) | Pb (ppm) | Zn (ppm) | Au (ppm) | Ag (ppm) | Mo (ppm) | W (ppm) |
|---|---|---|---|---|---|---|---|---|
| 29828A | Coarse-grained, garnet-epidote-diopside(?) skarn | 375 | 20 | 20 | 0.13 | 0.2 | 3 | 2 |
| 29828B | Garnet-diopside skarn with veins of coarse hematite and small clots of chrysocolla(?) | 1500 | 25 | 325 | 0.14 | 0.6 | 2 | 5 |
| 29828C | Red, fine-grained altered limestone(?) | 240 | 415 | 70 | 0.11 | 4.0 | 2 | 5 |

All of the samples are anomalous in copper and gold. This indicates that the granodiorite-skarn system is enriched in copper and gold.



G. Fernett, W. Jones (10/82)

**Garnet GRA, Montana**

*Geologic Sketch Map of Top-O-Deep Area, Wales Creek WSA (075-151)*

# APPENDIX IV

## Geochemical Data

## TABLE1. ROCK SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1°x2°CUSMAP QUADRANGLE,MONTANA(continued)

| MAP # | SAMPLE | LATITUDE | LONGITUDE | S-FE% | S-MG% | S-CA% | S-TI% | S-MN | S-AG | S-AS | S-AU | S-B | S-BA | S-BE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BAT7850R | 46 52 47 | 113 22 9 | <.05 | .05 | .10 | .003 | 20 | 1.5 | N | N | N | >5,000 | N |
| 2 | BAT7851R | 46 52 47 | 113 22 9 | 7.00 | 3.00 | 5.00 | .500 | 1,500 | N | N | N | N | 5,000 | 1.0 |
| 3 | BAT7852R | 46 52 47 | 113 22 9 | 3.00 | 1.50 | 5.00 | .500 | 500 | 7.0 | N | N | 300 | 1,500 | 1.5 |
| 4 | CL80025B | 46 55 41 | 113 22 11 | .05 | 1.00 | >20.00 | .010 | 200 | N | N | N | N | N | N |
| 5 | DRU7832R | 46 41 35 | 113 3 3 | .15 | .70 | >20.00 | .050 | 300 | <.5 | N | N | 15 | 30 | N |
| 6 | DRU7833R | 46 42 5 | 113 1 42 | 7.00 | 5.00 | 5.00 | .500 | 1,000 | N | N | N | N | 5,000 | 1.0 |
| 7 | E0010A | 46 50 20 | 113 21 55 | 3.00 | 2.00 | 3.00 | .300 | 1,000 | N | N | N | 10 | 1,500 | 1.5 |
| 8 | E0011A | 46 50 0 | 113 19 45 | 3.00 | 2.00 | 3.00 | .300 | 1,000 | N | N | N | 50 | 1,500 | 1.0 |
| 9 | E0137A | 46 48 45 | 113 19 55 | 3.00 | .70 | <.05 | .070 | 2,000 | 20.0 | N | <10 | <10 | 100 | 1.0 |
| 10 | E0137B | 46 48 45 | 113 19 55 | 7.00 | .30 | <.05 | .100 | 70 | 1.5 | N | N | 10 | 150 | 1.5 |
| 11 | E0138A | 46 48 45 | 113 19 40 | 1.50 | <.02 | <.05 | .005 | 50 | 1.0 | N | N | N | 70 | 1.5 |
| 12 | E0139A | 46 48 55 | 113 18 0 | 10.00 | <.02 | <.05 | <.002 | 70 | 7.0 | N | N | N | 20 | 1.0 |
| 13 | E0140A | 46 49 0 | 113 17 45 | 10.00 | .02 | .05 | .015 | 50 | 5.0 | N | <10 | N | 30 | 3.0 |
| 14 | E0141A | 46 48 55 | 113 16 10 | 10.00 | 1.00 | 15.00 | .005 | 2,000 | 100.0 | N | N | N | 30 | 1.5 |
| 15 | E0142A | 46 49 0 | 113 16 15 | 7.00 | 3.00 | 15.00 | .030 | 2,000 | N | N | N | N | 100 | 1.5 |
| 16 | E0142B | 46 49 0 | 113 16 15 | 10.00 | 1.50 | 20.00 | .200 | 5,000 | N | N | N | 10 | 150 | 1.0 |
| 17 | E0142C | 46 49 0 | 113 16 15 | 3.00 | 1.50 | 2.00 | .500 | 700 | N | N | N | N | 1,500 | 1.5 |
| 18 | E0143A | 46 49 30 | 113 15 30 | 10.00 | 1.50 | 10.00 | .010 | 5,000 | 100.0 | N | N | N | 20 | 7.0 |
| 19 | E0144A | 46 49 20 | 113 15 20 | 5.00 | 1.50 | 15.00 | .100 | 5,000 | <.5 | N | N | N | <20 | 7.0 |
| 20 | E0146A | 46 49 25 | 113 19 45 | 15.00 | .50 | 20.00 | .050 | 5,000 | N | N | N | N | 20 | N |
| 21 | E0146B | 46 49 25 | 113 19 45 | 1.50 | .02 | <.05 | .015 | 15 | 1.5 | N | N | <10 | 20 | 1.0 |
| 22 | E0148A | 46 49 40 | 113 20 40 | 5.00 | .07 | <.05 | .030 | 10 | 100.0 | N | 30 | 10 | 50 | <1.0 |
| 23 | E0148B | 46 49 40 | 113 20 40 | 1.00 | .03 | .20 | N | <10 | 1,000.0 | 7,000 | 20 | N | 5,000 | <1.0 |
| 24 | E0148C | 46 49 40 | 113 20 40 | 1.50 | <.02 | <.05 | N | <10 | 150.0 | 1,500 | 15 | 10 | >5,000 | <1.0 |
| 25 | E0154A | 46 48 35 | 113 18 55 | >20.00 | .30 | 3.00 | .100 | 700 | <.5 | N | N | N | 30 | N |
| 26 | E0154B | 46 48 35 | 113 18 55 | 15.00 | 3.00 | 10.00 | .015 | 1,500 | 2.0 | N | N | N | 200 | <1.0 |
| 27 | E0154C | 46 48 35 | 113 18 55 | >20.00 | .10 | .15 | .015 | 300 | 3.0 | N | N | N | 70 | N |
| 28 | E0154D | 46 48 35 | 113 18 55 | 15.00 | 5.00 | 7.00 | .010 | 1,500 | N | N | N | N | 30 | <1.0 |
| 29 | E0154E | 46 48 35 | 113 18 55 | 15.00 | 5.00 | 5.00 | .015 | 1,500 | 50.0 | N | N | N | 30 | 1.5 |
| 30 | E0155A | 46 49 35 | 113 19 35 | 15.00 | 3.00 | 20.00 | .100 | 3,000 | N | N | N | N | 20 | <1.0 |
| 31 | E0155B | 46 49 35 | 113 19 35 | 10.00 | 1.50 | 20.00 | .100 | 2,000 | N | N | N | N | 20 | N |
| 32 | E0155C | 46 49 35 | 113 19 35 | 15.00 | 7.00 | 7.00 | .030 | 2,000 | 15.0 | N | N | N | 700 | 2.0 |
| 33 | E0155D | 46 49 35 | 113 19 35 | 15.00 | 1.00 | 20.00 | .030 | 2,000 | .7 | N | N | N | 30 | N |
| 34 | E0155E | 46 49 35 | 113 19 35 | 15.00 | 2.00 | 20.00 | .070 | 3,000 | N | N | N | N | 30 | <1.0 |
| 35 | E0160A | 46 44 23 | 113 18 28 | 3.00 | 1.00 | 3.00 | .300 | 1,000 | N | N | N | N | 1,000 | 1.5 |
| 36 | ELV0196R | 46 49 39 | 113 20 42 | .70 | .07 | .50 | .010 | 200 | 20.0 | 200 | 30 | <10 | 1,500 | N |
| 37 | ELV0197R | 46 49 39 | 113 20 42 | 1.50 | 7.00 | 15.00 | .150 | 300 | 7.0 | N | N | 70 | 200 | 1.0 |
| 38 | ELV0198R | 46 49 39 | 113 20 42 | 10.00 | 1.50 | 5.00 | .100 | 700 | 15.0 | N | N | N | 20 | <1.0 |
| 39 | ELV0199R | 46 49 39 | 113 20 42 | 3.00 | 1.50 | 3.00 | .300 | 700 | N | N | N | 30 | 700 | 1.5 |
| 40 | ELV10200 | 46 49 25 | 113 20 6 | 5.00 | .15 | .07 | .070 | 200 | 100.0 | N | <10 | 20 | >5,000 | 1.0 |
| 41 | ELV1021R | 46 49 25 | 113 20 6 | 3.00 | 1.50 | 2.00 | .300 | 700 | N | N | N | 10 | 700 | 1.5 |
| 42 | ELV1022R | 46 49 25 | 113 20 6 | 3.00 | .70 | .05 | .500 | 200 | 1.5 | N | N | 70 | 1,000 | 3.0 |
| 43 | ELV5838R | 46 49 23 | 113 20 7 | 3.00 | 2.00 | 3.00 | .500 | 700 | N | N | N | 20 | 1,000 | 2.0 |
| 44 | ELV5839R | 46 49 23 | 113 20 7 | .70 | .10 | <.05 | .100 | 30 | 5.0 | N | N | <10 | >5,000 | 1.0 |
| 45 | ELV5840R | 46 49 23 | 113 19 2 | 7.00 | .30 | <.05 | .150 | 30 | 5.0 | N | N | 50 | 500 | 1.5 |
| 46 | ELV5843R | 46 48 58 | 113 17 55 | .15 | .20 | 7.00 | .007 | 100 | N | N | N | N | 70 | <1.0 |
| 47 | ELV5976R | 46 48 3 | 113 16 44 | .15 | 1.50 | 3.00 | <.002 | 300 | 30.0 | 300 | N | 30 | N | N |
| 48 | ELV5981R | 46 49 6 | 113 19 51 | .70 | .02 | <.05 | .010 | 200 | 10.0 | N | <10 | N | 200 | <1.0 |
| 49 | ELV5982R | 46 49 6 | 113 19 51 | 2.00 | .70 | .07 | .300 | 70 | N | N | N | 20 | 150 | 1.5 |
| 50 | ELV5983R | 46 49 38 | 113 20 40 | .70 | 5.00 | 10.00 | .050 | 300 | <.5 | N | N | 30 | 500 | <1.0 |
| [illegible] | [illegible] | [illegible] | 113 15 20 | 10.00 | 1.00 | 15.00 | .050 | 5,000 | 5.0 | N | N | N | 100 | 1.5 |

## TABLE 1. ROCK SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1 x2 QUADRANGLE, MONTANA

| MAP # | SAMPLE | S-BI | S-CD | S-CO | S-CR | S-CU | S-LA | S-MO | S-NB | S-NI | S-PB | S-SB | S-SC | S-SN | S-SR | S-V | S-W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BAT7850R | N | N | N | <10 | <5 | <20 | N | N | N | <10 | N | <5 | N | >5,000 | <10 | N |
| 2 | BAT7851R | N | N | 10 | 50 | 20 | 70 | N | N | 20 | 30 | N | 15 | N | 500 | 150 | N |
| 3 | BAT7852R | N | N | 7 | 50 | 5 | 70 | N | <20 | 10 | 20 | N | 15 | N | 300 | 150 | N |
| 4 | CL80025B | N | N | N | N | <5 | <20 | N | N | N | <10 | N | N | N | 300 | 10 | N |
| 5 | DRU7832R | N | N | N | 15 | 5 | <20 | N | N | <5 | 50 | N | 5 | N | 150 | 15 | N |
| 6 | DRU7833R | N | N | 15 | 200 | 30 | 200 | N | 30 | 150 | 50 | N | 15 | N | 2,000 | 150 | N |
| 7 | E0010A | N | N | 7 | 30 | 10 | 30 | N | N | 7 | 30 | N | 10 | N | 700 | 100 | N |
| 8 | E0011A | N | N | 7 | 70 | 20 | <20 | N | N | 10 | 30 | N | 10 | N | 500 | 70 | N |
| 9 | E0137A | N | N | <5 | 15 | 70 | <20 | N | N | 5 | 10 | N | N | N | N | 20 | N |
| 10 | E0137B | N | N | N | 20 | 70 | 20 | <5 | N | 5 | <10 | N | <5 | N | N | 50 | <50 |
| 11 | E0138A | N | N | N | 10 | 30 | 20 | N | N | 5 | <10 | N | N | N | N | 10 | N |
| 12 | E0139A | 20 | N | 5 | 15 | 1,500 | 20 | 70 | N | 7 | 100 | 300 | N | N | N | 100 | N |
| 13 | E0140A | 30 | N | 10 | 15 | 700 | <20 | 50 | N | 5 | 50 | 150 | N | N | N | 15 | N |
| 14 | E0141A | N | N | 10 | 10 | >20,000 | <20 | N | N | 5 | <10 | <100 | N | N | N | 30 | 50 |
| 15 | E0142A | N | N | 7 | 15 | 1,500 | 20 | N | N | 7 | 15 | N | <5 | N | N | 70 | N |
| 16 | E0142B | N | N | 7 | 70 | 300 | N | N | N | 15 | 10 | N | 7 | N | 200 | 150 | N |
| 17 | E0142C | N | N | 7 | 50 | 15 | 50 | N | N | 20 | 30 | N | 10 | N | 1,000 | 150 | N |
| 18 | E0143A | 15 | N | 30 | 10 | 20,000 | <20 | 7 | N | 30 | 15 | <100 | N | N | N | 100 | 50 |
| 19 | E0144A | N | N | 7 | N | 50 | <20 | 30 | N | 7 | <10 | N | <5 | 20 | 300 | 150 | 200 |
| 20 | F0146A | N | N | 15 | <10 | 150 | N | <5 | N | 5 | 20 | N | N | 15 | N | 300 | <50 |
| 21 | E0146B | 10 | N | <5 | N | 30 | <20 | 20 | N | <5 | 30 | N | N | N | N | 10 | N |
| 22 | E0148A | 15 | N | 7 | N | 100 | <20 | 10 | N | 10 | 7,000 | <100 | N | N | N | 10 | N |
| 23 | E0148B | 300 | 500 | 10 | N | >20,000 | 50 | <5 | N | 5 | 10,000 | >10,000 | N | N | 150 | N | N |
| 24 | E0148C | 100 | 100 | 7 | N | 20,000 | 50 | N | N | 5 | 500 | 10,000 | N | N | 150 | N | N |
| 25 | E0154A | N | N | N | 20 | 1,000 | <20 | 70 | N | <5 | 20 | N | 5 | N | N | 70 | N |
| 26 | E0154B | N | N | 200 | 15 | 3,000 | N | 10 | N | 10 | 50 | N | N | N | N | 100 | <50 |
| 27 | E0154C | N | N | 300 | 30 | 3,000 | N | 10 | N | 30 | 15 | N | N | N | N | 10 | N |
| 28 | E0154D | N | N | 20 | 10 | 700 | N | N | N | <5 | 10 | N | N | N | N | 100 | N |
| 29 | E0154E | N | N | 30 | 15 | >20,000 | N | 300 | N | 10 | 10 | N | N | N | N | 50 | 300 |
| 30 | E0155A | N | N | 30 | 30 | 500 | <20 | 100 | N | 20 | 15 | N | 5 | <10 | N | 300 | 300 |
| 31 | E0155B | N | N | 10 | 30 | 70 | <20 | 50 | N | 7 | 10 | N | 5 | N | <100 | 300 | 200 |
| 32 | E0155C | N | N | 70 | 10 | 20,000 | N | 300 | N | 50 | 15 | N | N | N | <100 | 150 | 700 |
| 33 | E0155D | N | N | 20 | 10 | 15,000 | N | 200 | N | 5 | 20 | N | N | <10 | N | 700 | 300 |
| 34 | E0155E | N | N | 15 | 20 | 100 | N | 150 | N | 15 | 20 | N | 5 | 50 | 150 | 500 | 700 |
| 35 | E0160A | N | N | 7 | <10 | <5 | 20 | N | N | 5 | 20 | N | 7 | N | 700 | 70 | N |
| 37 | ELV0197R | N | N | 7 | 20 | 100 | 20 | N | <20 | 30 | 200 | N | <5 | N | 100 | 50 | N |
| 38 | ELV0198R | N | N | 150 | 15 | 10,000 | 20 | 300 | N | 5 | 15 | N | 5 | N | 150 | 30 | 70 |
| 39 | ELV0199R | N | N | 10 | 15 | 30 | 200 | N | <20 | 10 | 30 | N | 7 | N | 300 | 70 | N |
| 40 | ELV10200 | 10 | N | 15 | <10 | 7,000 | 20 | N | N | 10 | 50 | 3,000 | 5 | N | <100 | 20 | N |
| 41 | ELV1021R | N | N | 10 | 10 | 7 | 30 | N | <20 | 7 | 20 | N | 7 | N | 500 | 100 | N |
| 42 | ELV1022R | N | N | 10 | 70 | 30 | 50 | N | <20 | 15 | 30 | N | 10 | N | N | 70 | N |
| 43 | ELV5838R | N | N | 10 | 30 | 5 | 20 | N | N | 7 | 30 | N | 10 | N | 700 | 200 | N |
| 44 | ELV5839R | N | N | <5 | 20 | 30 | 20 | N | N | 5 | 50 | N | 5 | N | 150 | 30 | N |
| 45 | ELV5840R | 10 | N | 7 | 70 | 500 | 20 | 70 | N | 7 | 50 | 150 | 7 | N | N | 70 | N |
| 46 | ELV5843R | N | N | 5 | 15 | 5 | 20 | N | N | 5 | <10 | N | N | N | <100 | 10 | N |
| 47 | ELV5976R | <10 | 70 | 5 | N | 5,000 | <20 | N | N | <5 | 3,000 | 2,000 | N | N | N | 100 | N |
| 48 | ELV5981R | N | N | <5 | N | 15 | N | 150 | N | <5 | 15 | <100 | N | N | N | <10 | N |
| 49 | ELV5982R | <10 | N | <5 | 20 | 10 | 30 | <5 | N | 7 | 20 | N | 7 | N | N | 50 | N |
| 50 | ELV5983R | <10 | N | <5 | 10 | 300 | <20 | N | N | 7 | 30 | N | <5 | N | 100 | 10 | N |
| 51 | ELV5988R | <10 | N | 10 | 15 | 3,000 | N | N | N | 7 | 15 | N | 5 | N | 300 | 150 | 70 |

## TABLE 1. ROCK SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1°x2° CUSMAP QUADRANGLE, MONTANA (continued)

| MAP # | SAMPLE | S-Y | S-ZN | S-ZR | S-TH | AA-AU | AA-CU | AA-PB | AA-ZN | AA-AG | AA-CD | AA-BI | AA-SB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BAT7850R | <10 | N | N | N | -- | <1 | <1 | <1 | <.05 | .10 | 1 | N |
| 2 | BAT7851R | 20 | N | 150 | N | -- | 1 | 1 | 2 | <.05 | .10 | 1 | 1 |
| 3 | BAT7852R | 20 | N | 150 | N | -- | 1 | 3 | 17 | <.05 | .20 | <1 | N |
| 4 | CL80025U | <10 | N | <10 | N | N | -- | -- | -- | -- | -- | -- | -- |
| 5 | DRU7832R | 10 | N | 30 | N | -- | <1 | 12 | <1 | .09 | .45 | 2 | 1 |
| 6 | DRU7833R | 20 | N | 300 | N | -- | 7 | 4 | 29 | <.05 | .15 | 1 | N |
| 7 | E0010A | 20 | N | 100 | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 8 | E0011A | 20 | N | 30 | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 9 | E0137A | N | N | 30 | N | 50.00 | -- | -- | -- | -- | -- | -- | -- |
| 10 | E0137B | 10 | N | 300 | N | 3.00 | -- | -- | -- | -- | -- | -- | -- |
| 11 | E0138A | N | N | N | N | 3.30 | -- | -- | -- | -- | -- | -- | -- |
| 12 | E0139A | 15 | N | N | N | 5.70 | -- | -- | -- | -- | -- | -- | -- |
| 13 | E0140A | N | N | N | N | 21.00 | -- | -- | -- | -- | -- | -- | -- |
| 14 | E0141A | N | N | N | N | .30 | -- | -- | -- | -- | -- | -- | -- |
| 15 | E0142A | 10 | 700 | N | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 16 | E0142B | 15 | N | 100 | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 17 | E0142C | 20 | N | 150 | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 18 | E0143A | N | 300 | N | N | .45 | -- | -- | -- | -- | -- | -- | -- |
| 19 | E0144A | 15 | N | 20 | N | .14 | -- | -- | -- | -- | -- | -- | -- |
| 20 | E0146A | <10 | N | N | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 21 | E0146B | N | N | 10 | N | 35.00 | -- | -- | -- | -- | -- | -- | -- |
| 22 | E0148A | N | N | 10 | N | 167.00 | -- | -- | -- | -- | -- | -- | -- |
| 23 | E0148B | N | 7,000 | N | N | 26.00 | -- | -- | -- | -- | -- | -- | -- |
| 24 | E0148C | N | 7,000 | <10 | N | 29.00 | -- | -- | -- | -- | -- | -- | -- |
| 25 | E0154A | <10 | N | 30 | N | .06 | -- | -- | -- | -- | -- | -- | -- |
| 26 | E0154B | N | N | N | N | .12 | -- | -- | -- | -- | -- | -- | -- |
| 27 | E0154C | <10 | N | N | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 28 | E0154D | N | N | <10 | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 29 | E0154E | N | N | <10 | N | .70 | -- | -- | -- | -- | -- | -- | -- |
| 30 | E0155A | 10 | N | 20 | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 31 | E0155B | 10 | N | 20 | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 32 | E0155C | 10 | N | <10 | N | .50 | -- | -- | -- | -- | -- | -- | -- |
| 33 | E0155D | N | N | <10 | N | .30 | -- | -- | -- | -- | -- | -- | -- |
| 34 | E0155E | 15 | N | <10 | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 35 | E0160A | 15 | N | 150 | N | <.05 | -- | -- | -- | -- | -- | -- | -- |
| 36 | ELV0196R | N | <200 | 10 | N | 17.00 | >1,000 | 150 | 22 | 14.60 | .23 | 22 | 85 |
| 37 | ELV0197R | 10 | N | 30 | N | -- | 130 | 200 | 30 | 2.19 | .27 | 2 | 9 |
| 38 | ELV0198R | 15 | N | 70 | N | 1.00 | >1,000 | N | 55 | 9.80 | .46 | 6 | 6 |
| 39 | ELV0199R | 20 | N | 100 | N | -- | 10 | 3 | 4 | <.05 | .11 | N | 1 |
| 40 | ELV10200 | <10 | 1,000 | 100 | N | 60.00 | >1,000 | 17 | 55 | 37.90 | 1.63 | 4 | 250 |
| 41 | ELV1021R | 15 | N | 70 | N | -- | 23 | 4 | 13 | 2.31 | .10 | N | 15 |
| 42 | ELV1022R | 30 | N | 300 | N | -- | 2 | 2 | 4 | N | .09 | N | N |
| 43 | ELV5838R | 20 | N | 150 | N | -- | 2 | 4 | 2 | <.05 | .05 | <1 | 1 |
| 44 | ELV5839R | <10 | N | 100 | N | -- | 22 | 6 | 1 | 3.00 | .05 | <1 | 7 |
| 45 | ELV5840R | 15 | N | 100 | N | -- | 500 | 13 | 3 | 2.60 | .14 | 3 | 34 |
| 46 | ELV5843R | <10 | N | 10 | N | -- | 2 | 2 | 4 | <.05 | .14 | <1 | 1 |
| 47 | ELV5976R | N | 200 | <10 | N | -- | >5,000 | 3,000 | 200 | 20.00 | 60.00 | <1 | >1,000 |
| 48 | ELV5981R | N | N | <10 | N | -- | 17 | 7 | 3 | 9.30 | .12 | 3 | <1 |
| 49 | ELV5982R | 20 | N | 200 | N | -- | 20 | 13 | 5 | .07 | .20 | <1 | 5 |
| 50 | ELV5983R | 10 | N | 20 | N | -- | 250 | 18 | 10 | .57 | .20 | <1 | 13 |
|  | [illegible] | [illegible] | [illegible] | 10 | N | -- | 3,000 | 7 | 28 | 3.59 | .75 | <1 | N |

LATITUDE 46°30'-47°00' LONGITUDE 113°00'-113°30'

TABLE 2.PAN-CONCENTRATE SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1°x2°CUSMAP QUADRANGLE, MONTANA(continued)

| MAP # | SAMPLE | LATITUDE | LONGITUDE | S-FE% | S-MG% | S-CA% | S-TI% | S-MN | S-AG | S-AS | S-AU | S-B | S-BA | S-BE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52 | BAT7849P | 46 52 43 | 113 20 34 | 30.0 | 3.00 | 5.00 | 2.00 | 2,000 | N | N | N | N | 70 | <2 |
| 53 | BAT7855P | 46 53 50 | 113 21 47 | 3.0 | .30 | .20 | .50 | 300 | N | N | N | 70 | >10,000 | 2 |
| 54 | BAT7857P | 46 53 54 | 113 21 44 | 5.0 | .50 | .50 | .70 | 300 | N | N | N | 150 | 700 | <2 |
| 55 | BAT7859P | 46 53 6 | 113 18 35 | 50.0 | 1.00 | 3.00 | >2.00 | 2,000 | N | N | N | N | 150 | N |
| 56 | BAT7861P | 46 54 20 | 113 16 10 | 15.0 | 3.00 | 5.00 | 2.00 | 2,000 | N | N | N | 200 | 300 | <2 |
| 57 | BAT7864P | 46 56 13 | 113 15 34 | 1.5 | 1.00 | 1.00 | .20 | 300 | 10.0 | N | N | 200 | 500 | 2 |
| 58 | BAT7866P | 46 59 4 | 113 15 9 | 3.0 | .70 | .15 | .70 | 500 | N | N | N | 150 | 1,500 | 2 |
| 59 | BAT7869P | 46 58 28 | 113 16 11 | 3.0 | .70 | .20 | .50 | 300 | N | N | N | 150 | 300 | 2 |
| 60 | BAT7871P | 46 58 43 | 113 16 56 | 3.0 | .70 | .10 | .50 | 700 | N | N | N | 150 | 300 | 2 |
| 61 | BAT7873P | 46 58 41 | 113 16 58 | 3.0 | .70 | .15 | .50 | 700 | N | N | N | 150 | 300 | 3 |
| 62 | BAT7879P | 46 54 20 | 113 20 11 | 3.0 | .50 | .30 | .70 | 500 | N | N | N | 200 | 200 | N |
| 63 | BAT7881P | 46 55 23 | 113 20 35 | 3.0 | 1.50 | .30 | .30 | 500 | N | N | N | 150 | 1,000 | 3 |
| 64 | BAT7883P | 46 55 23 | 113 20 30 | 2.0 | 1.00 | .50 | .20 | 300 | N | N | N | 70 | 300 | 2 |
| 65 | BAT7885P | 46 56 2 | 113 20 39 | 2.0 | .70 | .15 | .30 | 150 | N | N | N | 150 | 300 | 2 |
| 66 | BAT7887P | 46 58 29 | 113 19 21 | 3.0 | 1.00 | 1.50 | .30 | 500 | N | N | N | N | 5,000 | 3 |
| 67 | BAT7889P | 46 57 34 | 113 18 47 | 3.0 | 1.00 | 2.00 | .70 | 500 | N | N | N | N | 1,500 | <2 |
| 68 | BAT7891P | 46 57 15 | 113 17 44 | 3.0 | 1.00 | .30 | .50 | 700 | N | N | N | 200 | 1,500 | 3 |
| 69 | BRO8840P | 46 56 20 | 113 7 28 | 3.0 | .70 | .70 | .70 | 700 | N | N | N | 100 | 300 | <2 |
| 70 | BRO8842P | 46 55 40 | 113 6 48 | 20.0 | 1.00 | 2.00 | >2.00 | 2,000 | N | N | N | 30 | 200 | N |
| 71 | BRO8844P | 46 55 41 | 113 6 37 | 15.0 | .70 | 1.00 | >2.00 | 1,500 | N | N | N | 150 | 300 | N |
| 72 | BRO8847P | 46 53 29 | 113 5 54 | 5.0 | 1.00 | 1.00 | 2.00 | 1,500 | N | N | N | 50 | 1,000 | <2 |
| 73 | BRO8849P | 46 54 5 | 113 6 39 | 7.0 | 1.00 | 1.00 | 2.00 | 1,000 | N | N | N | 50 | 300 | <2 |
| 74 | BRO8851P | 46 53 26 | 113 6 52 | 5.0 | 1.00 | 2.00 | 2.00 | 1,500 | N | N | N | 30 | 300 | <2 |
| 75 | BRO8853P | 46 52 51 | 113 7 15 | 3.0 | 5.00 | 5.00 | .70 | 1,000 | N | N | N | N | 2,000 | <2 |
| 76 | BRO8856P | 46 52 40 | 113 2 43 | 3.0 | 2.00 | 2.00 | .70 | 700 | N | N | N | 30 | 1,500 | 2 |
| 77 | CHL7950P | 46 48 26 | 113 3 38 | 3.0 | 1.50 | 3.00 | 1.00 | 1,000 | N | N | N | 20 | 10,000 | 2 |
| 78 | CHL7952P | 46 48 48 | 113 5 49 | 7.0 | 1.50 | 2.00 | .70 | >10,000 | N | N | N | 20 | 5,000 | 3 |
| 79 | CHL7981P | 46 49 42 | 113 4 47 | 7.0 | 5.00 | 5.00 | 1.50 | 1,500 | N | N | N | N | 3,000 | <2 |
| 80 | CHL7985P | 46 50 45 | 113 5 0 | 7.0 | 7.00 | 7.00 | 1.00 | 1,500 | N | N | N | 30 | 3,000 | <2 |
| 81 | CHL7988P | 46 51 3 | 113 6 52 | 5.0 | 3.00 | 3.00 | 1.00 | 5,000 | N | N | N | N | 5,000 | <2 |
| 82 | CHL7991P | 46 51 47 | 113 4 17 | 7.0 | 1.50 | 1.00 | .70 | 5,000 | N | N | N | 70 | 2,000 | 3 |
| 83 | CHL7995P | 46 49 35 | 113 0 41 | 5.0 | 2.00 | 3.00 | 1.00 | 2,000 | N | N | N | 20 | 3,000 | 2 |
| 84 | CHL8810P | 46 49 4 | 113 2 27 | 10.0 | 1.50 | 5.00 | 1.00 | 2,000 | N | N | N | N | >10,000 | 3 |
| 85 | CHL8812P | 46 49 0 | 113 3 0 | 5.0 | 1.50 | 3.00 | .70 | 3,000 | N | N | N | N | 3,000 | 2 |
| 86 | CHL8814P | 46 48 18 | 113 2 28 | 5.0 | 1.00 | 3.00 | .70 | 1,000 | N | N | N | N | 5,000 | 3 |
| 87 | CHL8820P | 46 45 46 | 113 1 12 | 3.0 | 1.50 | 3.00 | .50 | 2,000 | N | N | N | N | 5,000 | 3 |
| 88 | CHL8822P | 46 46 15 | 113 1 55 | 5.0 | 1.50 | 2.00 | .70 | 700 | N | N | N | 20 | >10,000 | 2 |
| 89 | CHL8824P | 46 46 26 | 113 2 10 | 2.0 | .50 | 1.00 | .30 | 300 | N | N | N | N | 1,500 | 2 |
| 90 | DRU3434P | 46 43 42 | 113 13 51 | .7 | 3.00 | 30.00 | .05 | 300 | N | N | N | N | 500 | N |
| 91 | DRU3436P | 46 43 47 | 113 13 42 | 1.0 | 5.00 | 50.00 | .15 | 700 | N | N | N | 50 | 150 | N |
| 92 | DRU3439P | 46 41 50 | 113 11 24 | 5.0 | .70 | 7.00 | .15 | 1,500 | N | N | N | 100 | 500 | 2 |
| 93 | DRU3441P | 46 40 54 | 113 10 20 | 7.0 | .70 | 3.00 | .50 | 1,000 | N | N | N | 50 | 5,000 | 2 |
| 94 | DRU3444P | 46 41 21 | 113 9 9 | 7.0 | 1.00 | 1.50 | .70 | 700 | N | N | N | 70 | 2,000 | <2 |
| 95 | DRU3446P | 46 41 20 | 113 9 4 | 10.0 | 1.00 | 1.50 | .70 | 1,000 | N | N | N | 100 | 7,000 | <2 |
| 96 | DRU3447P | 46 42 56 | 113 12 25 | 1.5 | 1.00 | 20.00 | .15 | 500 | N | N | N | N | 150 | 2 |

| SAMPLE | S-BI | S-CD | S-CO | S-CR | S-CU | S-LA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BAT7849P | N | N | 20 | 150 | 50 | 100 | N | 70 | 10 | 20 | N | 15 | N | 200 | 700 | N |
| BAT7855P | N | N | <10 | 70 | <10 | 70 | N | N | 15 | <20 | N | <10 | N | 300 | 100 | N |
| BAT7857P | N | N | <10 | 100 | 70 | 150 | N | <50 | 10 | 50 | N | 10 | N | N | 150 | N |
| BAT7859P | N | N | 10 | 500 | 100 | 200 | N | <50 | 30 | 30 | N | 10 | <20 | N | 700 | N |
| BAT7861P | N | N | 20 | 300 | 15 | 150 | N | 70 | 50 | 20 | N | 15 | N | 200 | 500 | <100 |
| BAT7864P | N | N | N | 30 | 10 | <50 | N | N | 10 | 1,000 | N | <10 | N | N | 30 | N |
| BAT7866P | N | N | 10 | 70 | 10 | 50 | N | N | 10 | 20 | N | <10 | N | N | 150 | N |
| BAT7869P | N | N | 10 | 70 | <10 | 50 | N | <50 | 10 | <20 | N | <10 | N | N | 50 | N |
| BAT7871P | N | N | 10 | 70 | 10 | 50 | N | N | 15 | 70 | N | 10 | N | N | 70 | N |
| BAT7873P | N | N | 10 | 100 | 15 | 50 | N | <50 | 20 | 30 | N | 20 | N | N | 70 | N |
| BAT7879P | N | N | <10 | 50 | 10 | 70 | N | N | <10 | <20 | N | <10 | N | N | 70 | N |
| BAT7881P | N | N | <10 | 50 | <10 | 50 | N | N | 15 | 50 | N | <10 | N | N | 50 | N |
| BAT7883P | N | N | <10 | 30 | <10 | 50 | N | N | 15 | <20 | N | <10 | N | N | 50 | N |
| BAT7885P | N | N | N | 50 | <10 | 50 | N | N | 10 | <20 | N | <10 | N | N | 50 | N |
| BAT7887P | N | N | 10 | 50 | 10 | 70 | N | N | 50 | 70 | N | <10 | N | 1,000 | 70 | N |
| BAT7889P | N | N | <10 | 70 | <10 | 700 | N | N | 20 | 50 | N | <10 | N | 1,000 | 100 | N |
| BAT7891P | N | N | <10 | 50 | <10 | 70 | N | N | 15 | <20 | N | <10 | N | N | 70 | N |
| BRO8840P | N | N | 10 | 50 | 10 | <50 | N | N | 10 | <20 | N | 10 | N | N | 200 | N |
| BRO8842P | N | N | 20 | 150 | 30 | 300 | N | <50 | 10 | 30 | N | <10 | N | N | 1,000 | N |
| BRO8844P | N | N | 20 | 70 | 30 | 150 | N | <50 | 10 | 20 | N | <10 | N | N | 300 | N |
| BRO8847P | N | N | 15 | 150 | 30 | 50 | N | N | 50 | 30 | N | 10 | N | 500 | 200 | N |
| BRO8849P | N | N | 15 | 100 | 20 | 50 | N | N | 20 | <20 | N | <10 | N | 200 | 500 | N |
| BRO8851P | N | N | 15 | 150 | 50 | 70 | N | <50 | 10 | <20 | N | <10 | N | <200 | 150 | N |
| BRO8853P | N | N | 15 | 500 | 30 | 70 | N | N | 100 | 20 | N | 20 | N | 1,000 | 100 | N |
| BRO8856P | N | N | 10 | 200 | 10 | 70 | N | N | 50 | <20 | N | 15 | N | 700 | 70 | N |
| CHL7950P | N | N | 15 | 150 | 30 | 70 | N | N | 70 | 30 | N | 10 | N | 1,000 | 100 | N |
| CHL7952P | N | N | 100 | 150 | 30 | 100 | N | N | 150 | 50 | N | 10 | N | 2,000 | 100 | N |
| CHL7981P | N | N | 30 | 1,000 | 30 | 150 | N | <50 | 150 | 30 | N | 20 | N | 1,500 | 300 | N |
| CHL7985P | N | N | 100 | 1,000 | 50 | 150 | N | <50 | 150 | 30 | N | 30 | N | 2,000 | 300 | N |
| CHL7988P | N | N | 20 | 300 | 50 | 150 | N | <50 | 150 | 70 | N | 15 | N | 3,000 | 200 | N |
| CHL7991P | N | N | 20 | 300 | 20 | 100 | N | N | 70 | 50 | N | 10 | N | 500 | 150 | N |
| CHL7995P | N | N | 10 | 150 | 30 | 150 | N | N | 70 | 50 | N | 10 | N | 1,000 | 200 | N |
| CHL8810P | N | N | 20 | 300 | 70 | 700 | N | <50 | 100 | 30 | N | 10 | N | 2,000 | 200 | N |
| CHL8812P | N | N | 20 | 200 | 20 | 70 | N | <50 | 70 | 30 | N | 10 | N | 2,000 | 150 | N |
| CHL8814P | N | N | 20 | 150 | 20 | 70 | N | <50 | 70 | 30 | N | 10 | N | 2,000 | 100 | N |
| CHL8820P | N | N | 15 | 150 | 20 | 70 | N | N | 70 | 50 | N | <10 | N | 1,500 | 100 | N |
| CHL8822P | N | N | 15 | 150 | 70 | 70 | N | <50 | 50 | 20 | N | <10 | N | 2,000 | 100 | N |
| CHL8824P | N | N | <10 | 70 | <10 | 50 | N | N | 20 | 20 | N | N | N | 700 | 30 | N |
| DRU3434P | N | N | N | 50 | <10 | 50 | N | N | 10 | 20 | N | N | N | 300 | 50 | N |
| DRU3436P | N | N | N | 70 | <10 | 50 | N | N | 30 | 30 | N | N | N | 200 | 70 | N |
| DRU3439P | N | N | 10 | 100 | 50 | <50 | N | N | 10 | 50 | N | <10 | N | N | 70 | N |
| DRU3441P | N | N | 10 | 100 | 30 | 50 | N | N | 30 | 20 | N | <10 | N | 200 | 150 | N |
| DRU3444P | N | N | 10 | 150 | 50 | 50 | N | N | 30 | 20 | N | 10 | N | 200 | 200 | N |
| DRU3446P | N | N | 15 | 200 | 70 | 50 | N | N | 30 | 30 | N | 10 | N | 200 | 300 | N |
| DRU3447P | N | N | N | 70 | <10 | <50 | N | N | 10 | <20 | N | N | N | 200 | 70 | N |
| DRU3449P | N | N | <10 | 50 | <10 | 50 | 10 | N | 20 | <20 | N | <10 | N | <200 | 70 | N |

| MAP # | SAMPLE | S-Y | S-ZN | S-ZR | S-TH | AA-AU |
|---|---|---|---|---|---|---|
| 52 | BAT7849P | 200 | N | >2,000 | N | <.050 |
| 53 | BAT7855P | 30 | N | 300 | N | <.050 |
| 54 | BAT7857P | 70 | N | >2,000 | N | <.050 |
| 55 | BAT7859P | 300 | N | 1,000 | N | <.050 |
| 56 | BAT7861P | 200 | N | 1,000 | <200 | <.050 |
| 57 | BAT7864P | 20 | N | 300 | N | .100 |
| 58 | BAT7866P | 30 | N | 700 | N | <.050 |
| 59 | BAT7869P | 30 | N | 700 | N | <.050 |
| 60 | BAT7871P | 30 | N | 700 | N | <.050 |
| 61 | BAT7873P | 50 | N | 700 | N | <.050 |
| 62 | BAT7879P | 50 | N | >2,000 | N | <.050 |
| 63 | BAT7881P | <20 | N | 200 | N | <.050 |
| 64 | BAT7883P | 20 | N | 300 | N | <.050 |
| 65 | BAT7885P | 50 | N | 700 | N | <.050 |
| 66 | BAT7887P | N | N | 700 | N | <.050 |
| 67 | BAT7889P | <20 | N | 700 | N | <.050 |
| 68 | BAT7891P | 30 | N | 700 | N | .090 |
| 69 | BRO8840P | 30 | N | 300 | N | <.050 |
| 70 | BRO8842P | 300 | N | >2,000 | N | .090 |
| 71 | BRO8844P | 70 | N | >2,000 | N | <.050 |
| 72 | BRO8847P | 30 | N | 700 | N | <.050 |
| 73 | BRO8849P | 70 | N | 2,000 | N | <.050 |
| 74 | BRO8851P | 50 | N | >2,000 | N | <.050 |
| 75 | BRO8853P | <20 | N | 150 | N | <.050 |
| 76 | BRO8856P | 50 | N | 300 | N | <.050 |
| 77 | CHL7950P | 20 | N | 500 | N | N |
| 78 | CHL7952P | 20 | N | 300 | N | N |
| 79 | CHL7981P | 50 | N | 2,000 | N | N |
| 80 | CHL7985P | 50 | N | 500 | N | N |
| 81 | CHL7988P | 20 | N | 500 | N | N |
| 82 | CHL7991P | 20 | N | >2,000 | N | N |
| 83 | CHL7995P | 30 | N | 700 | N | N |
| 84 | CHL8810P | 100 | N | 200 | N | <.050 |
| 85 | CHL8812P | 20 | N | 300 | N | <.050 |
| 86 | CHL8814P | 20 | N | 200 | N | <.050 |
| 87 | CHL8820P | N | N | 150 | N | <.050 |
| 88 | CHL8822P | <20 | N | 300 | N | <.050 |
| 89 | CHL8824P | 50 | N | 150 | N | <.050 |
| 90 | DRU3434P | <20 | N | 20 | N | <.050 |
| 91 | DRU3436P | <20 | N | 70 | N | <.050 |
| 92 | DRU3439P | 30 | N | 700 | N | <.050 |
| 93 | DRU3441P | 20 | N | 700 | N | <.050 |
| 94 | DRU3444P | 30 | N | 200 | N | <.050 |
| 95 | DRU3446P | 50 | N | 500 | N | <.050 |
| 96 | DRU3447P | N | N | 150 | N | <.050 |
| 97 | DRU3449P | 20 | N | 100 | N | <.050 |

TABLE 2.PAN-CONCENTRATE SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1°x2°CUSMAP QUADRANGLE, MONTANA(continued)

| MAP# | SAMPLE | LATITUDE | LONGITUDE | S-FEX | S-MGX | S-CAX | S-TIX | S-MN | S-AG | S-AS | S-AU | S-B | S-BA | S-BE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 98 | DRU7825P | 46 40 15 | 113 2 24 | 3.0 | 7.00 | .50 | .50 | 500 | N | N | N | 150 | 700 | 2 |
| 99 | DRU7827P | 46 42 59 | 113 2 41 | 5.0 | 1.50 | 1.50 | .70 | 700 | N | N | N | N | 2,000 | 2 |
| 100 | DRU7829P | 46 43 10 | 113 2 49 | 3.0 | 1.00 | 1.50 | .50 | 700 | N | N | N | 20 | 2,000 | 2 |
| 101 | DRU7831P | 46 42 43 | 113 3 54 | 5.0 | .20 | .70 | .30 | 7,000 | N | N | N | N | 2,000 | 3 |
| 102 | DRU7835P | 46 42 48 | 113 0 5 | 1.5 | .50 | .70 | .20 | 300 | N | N | N | 20 | 700 | <2 |
| 103 | DRU7936P | 46 44 31 | 113 5 30 | 7.0 | .70 | 2.00 | 1.00 | 3,000 | N | N | N | 20 | 3,000 | 2 |
| 104 | DRU7938P | 46 43 24 | 113 5 23 | 5.0 | .15 | .70 | .20 | 500 | N | N | N | <20 | 500 | 2 |
| 105 | DRU7940P | 46 41 4 | 113 5 41 | 7.0 | .70 | .70 | .70 | 300 | N | N | N | 70 | 10,000 | <2 |
| 106 | DRU7942P | 46 40 51 | 113 5 34 | 5.0 | 1.50 | 7.00 | .50 | 1,500 | N | N | N | 50 | 1,500 | 2 |
| 107 | DRU7944P | 46 40 25 | 113 5 41 | 20.0 | 1.00 | 1.50 | 1.50 | 1,000 | N | N | N | 20 | >10,000 | N |
|  | DRU7946P | 46 38 43 | 113 6 2 | 5.0 | 1.00 | .70 | .30 | 700 | N | N | N | 30 | 1,000 | 3 |
| 108 | ELV1000 | 46 49 37 | 113 20 52 | 10.0 | .50 | .20 | .30 | 500 | 1.5 | N | N | 500 | 2,000 | 5 |
| 109 | ELV1000 | 46 49 39 | 113 20 42 | 15.0 | 2.00 | 7.00 | .70 | 1,500 | 150.0 | N | 30 | 500 | >10,000 | 3 |
| 109 | ELV1000 | 46 49 39 | 113 20 42 | 15.0 | 2.00 | 5.00 | .70 | 1,000 | 200.0 | N | 500 | 30 | >10,000 | <2 |
| 110 | ELV1001 | 46 48 31 | 113 21 5 | 50.0 | .70 | 5.00 | .30 | 1,000 | <1.0 | N | N | N | 5,000 | N |
| 110 | ELV1001 | 46 48 31 | 113 21 5 | 15.0 | 1.50 | 15.00 | 1.00 | 2,000 | 15.0 | N | 20 | <20 | 7,000 | 2 |
| 111 | ELV1018 | 46 49 48 | 113 18 23 | 30.0 | 3.00 | 10.00 | .50 | 1,500 | N | N | N | 150 | 70 | N |
| 111 | ELV1018 | 46 49 48 | 113 18 23 | 10.0 | 5.00 | 15.00 | 1.00 | 700 | N | N | N | 100 | 50 | <2 |
| 112 | ELV1023 | 46 49 25 | 113 20 6 | 10.0 | .70 | .50 | .50 | 1,500 | 70.0 | N | 150 | 150 | >10,000 | 5 |
| 112 | ELV1023 | 46 49 25 | 113 20 6 | 10.0 | <.05 | <.50 | .30 | 50 | 50.0 | N | 700 | <20 | 200 | 3 |
| 113 | ELV1024P | 46 49 44 | 113 18 32 | 1.5 | 7.00 | 10.00 | .30 | 300 | N | N | N | 2,000 | 3,000 | 3 |
| 114 | ELV4858P | 46 52 22 | 113 22 23 | 15.0 | 2.00 | 7.00 | 1.50 | 1,500 | N | N | N | 50 | 500 | <2 |
| 115 | ELV5829P | 46 47 55 | 113 16 38 | 3.0 | 5.00 | 7.00 | .30 | 300 | N | N | N | 150 | 200 | <2 |
| 116 | ELV5831P | 46 46 53 | 113 20 32 | 2.0 | 3.00 | 15.00 | .10 | 300 | N | N | N | 50 | 700 | N |
| 117 | ELV5842P | 46 49 11 | 113 21 49 | 10.0 | 2.00 | 5.00 | .50 | 700 | N | N | N | <20 | 300 | 5 |
| 118 | ELV5845P | 46 49 14 | 113 21 41 | 30.0 | 1.50 | 3.00 | .30 | 500 | N | N | N | N | <50 | N |
| 119 | ELV5847P | 46 50 10 | 113 18 50 | 30.0 | .70 | 1.50 | .30 | 700 | N | N | N | N | <50 | N |
| 120 | ELV5849P | 46 51 45 | 113 21 14 | 50.0 | .30 | .70 | .30 | 700 | N | N | N | N | 150 | N |
| 121 | ELV5851P | 46 51 38 | 113 20 38 | 50.0 | .20 | .70 | .20 | 700 | N | N | N | N | 50 | N |
| 122 | ELV5855P | 46 50 9 | 113 17 30 | 15.0 | 2.00 | 5.00 | .70 | 1,500 | N | N | N | <20 | 150 | <2 |
| 123 | ELV5974P | 46 48 3 | 113 16 12 | 15.0 | .70 | 7.00 | 1.50 | 2,000 | N | N | N | 20 | 200 | N |
| 124 | ELV5975P | 46 48 3 | 113 16 44 | 3.0 | 3.00 | 7.00 | .30 | 300 | N | N | N | 200 | 150 | <2 |
| 125 | ELV5978P | 46 46 58 | 113 20 54 | 30.0 | .70 | 2.00 | 1.50 | 2,000 | N | N | N | N | 1,000 | N |
| 126 | ELV5984P | 46 48 29 | 113 21 17 | 5.0 | 1.00 | 3.00 | 1.50 | 500 | N | N | N | 50 | 700 | <2 |
| 127 | ELV5987P | 46 48 32 | 113 21 4 | 30.0 | .70 | 5.00 | .50 | 700 | 70.0 | N | 700 | N | 3,000 | N |
| 128 | ELV5990P | 46 49 14 | 113 17 19 | 20.0 | 1.50 | 7.00 | .70 | 1,000 | N | N | N | 20 | 300 | N |
| 129 | ELV5992P | 46 51 1 | 113 19 15 | 30.0 | 1.00 | 3.00 | 1.00 | 1,000 | N | N | N | N | 50 | N |
| 130 | ELV5994P | 46 51 40 | 113 20 58 | 30.0 | .15 | 1.00 | .30 | 700 | N | N | N | N | 70 | N |
| 131 | ELV5996P | 46 51 42 | 113 16 53 | 30.0 | 1.00 | 3.00 | 1.00 | 1,500 | N | N | N | 20 | 50 | N |
| 132 | ELV5998P | 46 51 23 | 113 18 6 | 7.0 | 1.50 | 5.00 | 1.50 | 1,500 | N | N | N | <20 | 200 | 2 |
| 133 | ELV6971P | 46 45 48 | 113 15 59 | 20.0 | 1.50 | 3.00 | 1.00 | 700 | N | <500 | N | 30 | 300 | 3 |
| 134 | ELY5831P | 46 46 54 | 113 20 31 | 10.0 | .70 | 2.00 | .70 | 700 | N | N | N | <20 | 200 | <2 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 98 | DRU7825P | N | N | 10 | 100 | 30 | <50 | N | <50 | 30 | 20 | N | <10 | N | N | 150 | N |
| 99 | DRU7827P | N | N | 15 | 200 | 15 | 100 | N | <50 | 50 | <20 | N | <10 | N | 700 | 100 | N |
| 100 | DRU7829P | N | N | 10 | 150 | 20 | 70 | N | N | 30 | 50 | N | <10 | N | 700 | 70 | N |
| 101 | DRU7831P | N | N | <10 | 50 | 70 | 50 | 15 | N | 70 | 50 | N | <10 | N | N | 150 | N |
| 102 | DRU7835P | N | N | 15 | 70 | <10 | <50 | N | N | 20 | <20 | N | <10 | N | <200 | 20 | N |
| 103 | DRU7936P | N | N | 20 | 100 | 50 | 150 | 10 | N | 50 | 70 | N | 10 | N | 700 | 200 | N |
| 104 | DRU7938P | N | N | N | 50 | 20 | 70 | N | N | 10 | 100 | N | <10 | 300 | N | 50 | N |
| 105 | DRU7940P | N | N | 10 | 100 | 70 | 70 | N | N | 15 | 50 | N | <10 | N | <200 | 300 | N |
| 106 | DRU7942P | N | N | 10 | 100 | 30 | 50 | N | N | 20 | <20 | N | <10 | N | <200 | 150 | N |
| 107 | DRU7944P | N | N | 15 | 200 | 150 | 50 | N | N | 50 | 50 | N | 10 | N | 300 | 700 | N |
| 108 | ELV1000 | N | N | 30 | 50 | 100 | 70 | N | <50 | 70 | 150 | <200 | 10 | N | N | 70 | N |
| 109 | ELV1000 | 500 | N | 70 | 70 | 3,000 | 200 | <10 | <50 | 100 | 3,000 | 1,000 | 10 | N | 700 | 200 | N |
| 109 | ELV1000 | 70 | N | 50 | 50 | 2,000 | 70 | 70 | <50 | 70 | 10,000 | 1,000 | 10 | N | 500 | 200 | 100 |
| 110 | ELV1001 | N | N | 70 | 1,000 | 70 | 50 | <10 | N | 70 | 100 | N | <10 | N | N | 1,500 | 150 |
| 110 | ELV1001 | N | N | 20 | 70 | 70 | 100 | 100 | <50 | 50 | 200 | N | 10 | N | <200 | 300 | 500 |
| 111 | ELV1018 | N | N | 150 | 300 | 70 | 50 | N | <50 | 70 | 500 | N | 10 | N | N | 1,500 | N |
| 111 | ELV1018 | N | N | 50 | 30 | 100 | 70 | N | <50 | 50 | 100 | N | <10 | N | N | 300 | <100 |
| 112 | ELV1023 | 70 | N | 10 | 150 | 2,000 | 70 | 700 | <50 | 20 | 5,000 | 2,000 | 10 | N | 5,000 | 200 | N |
| 112 | ELV1023 | N | N | 10 | 20 | 70 | N | <10 | 100 | 20 | 500 | N | <10 | N | N | 20 | N |
| 113 | ELV1024P | N | N | <10 | 70 | 20 | 200 | <10 | N | <10 | 100 | N | 15 | N | N | 70 | 500 |
| 114 | ELV4858P | N | N | 20 | 200 | 15 | 200 | N | 50 | 30 | 50 | N | 15 | N | 300 | 700 | N |
| 115 | ELV5829P | N | N | 15 | 50 | 50 | 50 | N | N | 20 | 300 | N | 10 | N | N | 200 | N |
| 116 | ELV5831P | N | N | 15 | 20 | 15 | <50 | N | N | 30 | 70 | N | N | 50 | <200 | 30 | N |
| 117 | ELV5842P | N | N | 15 | 200 | 10 | 100 | N | <50 | 20 | 70 | N | 15 | N | N | 300 | N |
| 118 | ELV5845P | N | N | 20 | 700 | 30 | <50 | N | N | 30 | 50 | N | 10 | N | N | 1,000 | N |
| 119 | ELV5847P | N | N | 30 | 1,000 | 50 | <50 | N | N | 50 | 30 | N | 10 | N | N | 1,000 | N |
| 120 | ELV5849P | N | N | 20 | 500 | 30 | <50 | N | N | 20 | <20 | N | 10 | N | N | 1,000 | N |
| 121 | ELV5851P | N | N | 30 | 700 | 50 | N | N | N | 20 | 20 | N | 10 | N | N | 1,000 | N |
| 122 | ELV5855P | N | N | 20 | 200 | 15 | 50 | N | <50 | 10 | <20 | N | 50 | N | 200 | 500 | N |
| 123 | ELV5974P | N | N | 30 | 100 | 70 | 200 | N | 50 | 30 | 50 | N | 15 | N | <200 | 700 | N |
| 124 | ELV5975P | N | N | 10 | 20 | 30 | <50 | N | N | 20 | 150 | N | <10 | N | N | 100 | N |
| 125 | ELV5978P | N | N | 70 | 500 | 150 | 1,000 | N | N | 100 | 100 | N | 10 | N | 200 | 700 | N |
| 126 | ELV5984P | N | N | 15 | 200 | 10 | 300 | N | <50 | 50 | 20 | N | 10 | N | 1,500 | 100 | N |
| 127 | ELV5987P | N | N | 30 | 700 | 50 | <50 | 20 | N | 50 | 70 | N | 10 | N | N | 1,000 | 150 |
| 128 | ELV5990P | N | N | 50 | 150 | 30 | 70 | N | <50 | 50 | 50 | N | 10 | 30 | N | 700 | N |
| 129 | ELV5992P | N | N | 50 | 300 | 50 | 100 | N | <50 | 30 | 30 | N | 10 | N | N | 1,000 | N |
| 130 | ELV5994P | N | N | 30 | 500 | 50 | <50 | N | N | 20 | 20 | N | <10 | N | N | 1,000 | N |
| 131 | ELV5996P | N | N | 50 | 500 | 30 | 50 | N | <50 | 50 | 20 | N | 15 | N | N | 700 | <100 |
| 132 | ELV5998P | N | N | 15 | 50 | 15 | 150 | N | 50 | <10 | 20 | N | 15 | N | 500 | 300 | N |
| 133 | ELV6971P | N | N | 100 | 300 | 150 | 150 | N | <50 | 100 | 500 | N | 15 | N | <200 | 500 | N |
| 134 | ELY5831P | N | N | 15 | 100 | 30 | 100 | N | <50 | 10 | 20 | N | 15 | N | 300 | 300 | N |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 98 | DRU7825P | N | N | 10 | 100 | 30 | <50 | N | <50 | 30 | 20 | N | <10 | N | N | 150 | N |
| 99 | DRU7827P | N | N | 15 | 200 | 15 | 100 | N | <50 | 50 | <20 | N | <10 | N | 700 | 100 | N |
| 100 | DRU7829P | N | N | 10 | 150 | 20 | 70 | N | N | 30 | 50 | N | <10 | N | 700 | 70 | N |
| 101 | DRU7831P | N | N | <10 | 50 | 70 | 50 | 15 | N | 70 | 50 | N | <10 | N | N | 150 | N |
| 102 | DRU7835P | N | N | 15 | 70 | <10 | <50 | N | N | 20 | <20 | N | <10 | N | <200 | 20 | N |
| 103 | DRU7936P | N | N | 20 | 100 | 50 | 150 | 10 | N | 50 | 70 | N | 10 | N | 700 | 200 | N |
| 104 | DRU7938P | N | N | N | 50 | 20 | 70 | N | N | 10 | 100 | N | <10 | 300 | N | 50 | N |
| 105 | DRU7940P | N | N | 10 | 100 | 70 | 70 | N | N | 15 | 50 | N | <10 | N | <200 | 300 | N |
| 106 | DRU7942P | N | N | 10 | 100 | 30 | 50 | N | N | 20 | <20 | N | <10 | N | <200 | 150 | N |
| 107 | DRU7944P | N | N | 15 | 200 | 150 | 50 | N | N | 50 | 50 | N | 10 | N | 300 | 700 | N |
| 108 | ELV1000 | N | N | 30 | 50 | 100 | 70 | N | <50 | 70 | 150 | <200 | 10 | N | N | 70 | N |
| 109 | ELV1000 | 500 | N | 70 | 70 | 3,000 | 200 | <10 | <50 | 100 | 3,000 | 1,000 | 10 | N | 700 | 200 | N |
| 109 | ELV1000 | 70 | N | 50 | 50 | 2,000 | 70 | 70 | <50 | 70 | 10,000 | 1,000 | 10 | N | 500 | 200 | 100 |
| 110 | ELV1001 | N | N | 70 | 1,000 | 70 | 50 | <10 | N | 70 | 100 | N | <10 | N | N | 1,500 | 150 |
| 110 | ELV1001 | N | N | 20 | 70 | 70 | 100 | 100 | <50 | 50 | 200 | N | 10 | N | <200 | 300 | 500 |
| 111 | ELV1018 | N | N | 150 | 300 | 70 | 50 | N | <50 | 70 | 500 | N | 10 | N | N | 1,500 | N |
| 111 | ELV1018 | N | N | 50 | 30 | 100 | 70 | N | <50 | 50 | 100 | N | <10 | N | N | 300 | <100 |
| 112 | ELV1023 | 70 | N | 10 | 150 | 2,000 | 70 | 700 | <50 | 20 | 5,000 | 2,000 | 10 | N | 5,000 | 200 | N |
| 112 | ELV1023 | N | N | 10 | 20 | 70 | N | <10 | 100 | 20 | 500 | N | <10 | N | N | 20 | N |
| 113 | ELV1024P | N | N | <10 | 70 | 20 | 200 | <10 | N | <10 | 100 | N | 15 | N | N | 70 | 500 |
| 114 | ELV4858P | N | N | 20 | 200 | 15 | 200 | N | 50 | 30 | 50 | N | 15 | N | 300 | 700 | N |
| 115 | ELV5829P | N | N | 15 | 50 | 50 | 50 | N | N | 20 | 300 | N | 10 | N | N | 200 | N |
| 116 | ELV5831P | N | N | 15 | 20 | 15 | <50 | N | N | 30 | 70 | N | N | 50 | <200 | 30 | N |
| 117 | ELV5842P | N | N | 15 | 200 | 10 | 100 | N | <50 | 20 | 70 | N | 15 | N | N | 300 | N |
| 118 | ELV5845P | N | N | 20 | 700 | 30 | <50 | N | N | 30 | 50 | N | 10 | N | N | 1,000 | N |
| 119 | ELV5847P | N | N | 30 | 1,000 | 50 | <50 | N | N | 50 | 30 | N | 10 | N | N | 1,000 | N |
| 120 | ELV5849P | N | N | 20 | 500 | 30 | <50 | N | N | 20 | <20 | N | 10 | N | N | 1,000 | N |
| 121 | ELV5851P | N | N | 30 | 700 | 50 | N | N | N | 20 | 20 | N | 10 | N | N | 1,000 | N |
| 122 | ELV5855P | N | N | 20 | 200 | 15 | 50 | N | <50 | 10 | <20 | N | 50 | N | 200 | 500 | N |
| 123 | ELV5974P | N | N | 30 | 100 | 70 | 200 | N | 50 | 30 | 50 | N | 15 | N | <200 | 700 | N |
| 124 | ELV5975P | N | N | 10 | 20 | 30 | <50 | N | N | 20 | 150 | N | <10 | N | N | 100 | N |
| 125 | ELV5978P | N | N | 70 | 500 | 150 | 1,000 | N | N | 100 | 100 | N | 10 | N | 200 | 700 | N |
| 126 | ELV5984P | N | N | 15 | 200 | 10 | 300 | N | <50 | 50 | 20 | N | 10 | N | 1,500 | 100 | N |
| 127 | ELV5987P | N | N | 30 | 700 | 50 | <50 | 20 | N | 50 | 70 | N | 10 | N | N | 1,000 | 150 |
| 128 | ELV5990P | N | N | 50 | 150 | 30 | 70 | N | <50 | 50 | 50 | N | 10 | 30 | N | 700 | N |
| 129 | ELV5992P | N | N | 50 | 300 | 50 | 100 | N | <50 | 30 | 30 | N | 10 | N | N | 1,000 | N |
| 130 | ELV5994P | N | N | 30 | 500 | 50 | <50 | N | N | 20 | 20 | N | <10 | N | N | 1,000 | N |
| 131 | ELV5996P | N | N | 50 | 500 | 30 | 50 | N | <50 | 50 | 20 | N | 15 | N | N | 700 | <100 |
| 132 | ELV5998P | N | N | 15 | 50 | 15 | 150 | N | 50 | <10 | 20 | N | 15 | N | 500 | 300 | N |
| 133 | ELV6971P | N | N | 100 | 300 | 150 | 150 | N | <50 | 100 | 500 | N | 15 | N | <200 | 500 | N |
| 134 | ELY5831P | N | N | 15 | 100 | 30 | 100 | N | <50 | 10 | 20 | N | 15 | N | 300 | 300 | N |

| | | | | | | |
|---|---|---|---|---|---|---|
| 98 | DRU7825P | 30 | N | 700 | N | <.050 |
| 99 | DRU7827P | <20 | N | 500 | N | <.050 |
| 100 | DRU7829P | 30 | N | 300 | N | <.050 |
| 101 | DRU7831P | <20 | N | 200 | N | <.050 |
| 102 | DRU7835P | N | N | 500 | N | <.050 |
| 103 | DRU7936P | 50 | N | 500 | N | N |
| 104 | DRU7938P | 30 | N | 300 | N | N |
| 105 | DRU7940P | 50 | N | >2,000 | N | N |
| 106 | DRU7942P | 20 | N | 300 | N | N |
| 107 | DRU7944P | 50 | N | 2,000 | N | N |
| 108 | ELV1000 | 100 | N | 1,000 | N | -- |
| 109 | ELV1000 | 50 | N | 300 | N | -- |
| 109 | ELV1000 | 30 | N | 700 | N | -- |
| 110 | ELV1001 | 50 | N | 700 | N | -- |
| 110 | ELV1001 | 100 | N | 1,500 | N | -- |
| 111 | ELV1018 | 50 | N | 1,000 | N | -- |
| 111 | ELV1018 | 70 | N | 700 | N | -- |
| 112 | ELV1023 | 50 | 500 | 700 | N | -- |
| 112 | ELV1023 | 100 | 2,000 | 1,000 | N | -- |
| 113 | ELV1024P | 30 | N | 2,000 | N | -- |
| 114 | ELV4858P | 200 | N | 700 | N | .420 |
| 115 | ELV5329P | N | N | 150 | N | <.050 |
| 116 | ELV5831P | N | N | 150 | N | <.050 |
| 117 | ELV5842P | 70 | N | 200 | N | <.050 |
| 118 | ELV5845P | 50 | N | 700 | N | 1.920 |
| 119 | ELV5847P | 50 | N | 1,000 | N | .630 |
| 120 | ELV5849P | 70 | N | 1,500 | N | 5.800 |
| 121 | ELV5851P | 70 | N | 1,500 | N | 4.900 |
| 122 | ELV5855P | 100 | N | 1,500 | N | <.050 |
| 123 | ELV5974P | 150 | N | 700 | N | 2.250 |
| 124 | ELV5975P | N | N | 700 | N | <.050 |
| 125 | ELV5978P | 100 | N | 1,500 | N | 29.600 |
| 126 | ELV5984P | 100 | N | 1,500 | N | .070 |
| 127 | ELV5987P | 70 | N | 1,500 | N | 5.640 |
| 128 | ELV5990P | 70 | N | 500 | N | .900 |
| 129 | ELV5992P | 200 | N | 2,000 | N | .640 |
| 130 | ELV5994P | 70 | N | 1,000 | N | 1.000 |
| 131 | ELV5996P | 150 | N | 1,500 | N | <.050 |
| 132 | ELV5998P | 200 | N | 1,500 | N | .100 |
| 133 | ELV6971P | 100 | N | 2,000 | N | 1.000 |
| 134 | ELY5831P | 150 | N | 1,500 | N | 28.900 |

# CHAPTER C

## LATITUDE 46°30'-47°00' LONGITUDE 113°00'-113°30'

TABLE 2.PAN-CONCENTRATE SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1°x2°CUSMAP QUADRANGLE, MONTANA(continued)

| MAP # | SAMPLE | LATITUDE | LONGITUDE | S-FE% | S-MG% | S-CA% | S-TI% | S-MN | S-AG | S-AS | S-AU | S-B | S-BA | S-BE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 135 | WIH5828P | 46 46 12 | 113 12 51 | 5.0 | .70 | 1.50 | .70 | 500 | N | N | N | 30 | 2,000 | <2 |
| 136 | WIH5861P | 46 47 52 | 113 12 10 | 3.0 | 1.00 | 2.00 | .70 | 700 | N | N | N | 20 | 1,000 | <2 |
| 137 | WIH5863P | 46 49 54 | 113 13 27 | 10.0 | 2.00 | 7.00 | .70 | 1,000 | N | N | N | <20 | 300 | N |
| 138 | WIH5865P | 46 47 29 | 113 8 26 | 5.0 | 1.50 | 1.50 | .50 | 700 | N | N | N | 20 | 1,000 | <2 |
| 139 | WIH5971P | 46 45 45 | 113 12 23 | 7.0 | 1.00 | 1.50 | .70 | 2,000 | N | N | N | 150 | 2,000 | <2 |
| 140 | WIH6901P | 46 47 40 | 113 11 55 | 15.0 | 2.00 | 3.00 | 2.00 | 700 | N | N | N | 20 | 500 | N |
| 141 | WIH6902P | 46 49 52 | 113 13 37 | 20.0 | 1.50 | 7.00 | .30 | 1,000 | N | N | N | N | <50 | N |
| 142 | WIH6905P | 46 47 9 | 113 9 53 | 7.0 | 2.00 | 3.00 | 1.00 | 2,000 | N | N | N | N | 2,000 | N |
| 143 | WIH7954P | 46 48 28 | 113 8 3 | 5.0 | 3.00 | 3.00 | .70 | 1,000 | N | N | N | 30 | 2,000 | 2 |
| 144 | WIH7956P | 46 49 57 | 113 10 25 | 7.0 | 5.00 | 5.00 | 1.00 | 1,500 | N | N | N | N | 2,000 | <2 |
| 145 | WIH7958P | 46 49 52 | 113 10 26 | 3.0 | 3.00 | 2.00 | .70 | 700 | N | N | N | 70 | 2,000 | 3 |
| 146 | WIH7960P | 46 49 22 | 113 9 28 | 10.0 | 3.00 | 3.00 | 1.50 | 7,000 | N | N | N | N | 5,000 | <2 |
| 147 | WIH7962P | 46 49 21 | 113 9 39 | 7.0 | 7.00 | 5.00 | 1.00 | 1,500 | N | N | N | N | 2,000 | <2 |
| 148 | WIH7964P | 46 48 15 | 113 13 3 | 7.0 | 1.50 | 1.50 | .70 | 2,000 | N | N | N | 50 | 2,000 | <2 |
| 149 | WIH7966P | 46 48 14 | 113 12 56 | 5.0 | 3.00 | 5.00 | 1.00 | 1,500 | N | N | N | 70 | 1,000 | 3 |
| 150 | WIH7968P | 46 48 56 | 113 13 23 | 10.0 | 7.00 | 10.00 | 1.00 | 3,000 | N | N | N | N | 1,000 | 2 |
| 151 | WIH7970P | 46 46 33 | 113 11 50 | 10.0 | 3.00 | 3.00 | 1.50 | 3,000 | N | N | N | 20 | 3,000 | 3 |
| 152 | WIH7972P | 46 45 19 | 113 11 48 | 5.0 | 3.00 | 3.00 | 1.00 | 1,000 | N | N | N | 20 | 2,000 | <2 |
| 153 | WIH7974P | 46 45 38 | 113 8 39 | 5.0 | 2.00 | 2.00 | .70 | 700 | N | N | N | 30 | 3,000 | 2 |
| 154 | WIH7976P | 46 46 29 | 113 8 12 | 3.0 | .70 | 2.00 | 1.50 | 1,500 | N | N | N | N | 1,500 | 2 |
| 155 | WIH7978P | 46 46 27 | 113 8 4 | 5.0 | 1.00 | 3.00 | 1.50 | 1,500 | N | N | N | N | 2,000 | <2 |

LATITUDE 46°30'-47°00' LONGITUDE 113°00'-113°30'

TABLE 2.PAN-CONCENTRATE SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1°x2°CUSMAP QUADRANGLE, MONTANA(continued)

| MAP # | SAMPLE | S-BI | S-CD | S-CO | S-CR | S-CU | S-LA | S-MO | S-NB | S-NI | S-PB | S-SB | S-SC | S-SN | S-SR | S-V | S-W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 135 | WIHS828P | N | N | 15 | 150 | 15 | 50 | N | N | 70 | 50 | N | 10 | 150 | 1,000 | 70 | N |
| 136 | WIHS861P | N | N | 15 | 300 | 15 | 50 | N | <50 | 70 | 70 | N | 10 | 70 | 700 | 100 | N |
| 137 | WIHS863P | N | N | 30 | 700 | 30 | 50 | N | N | 150 | 30 | N | 50 | N | 200 | 200 | N |
| 138 | WIHS865P | N | N | 15 | 500 | 20 | 70 | N | N | 100 | 30 | N | 10 | N | 1,000 | 100 | N |
| 139 | WIHS971P | N | N | 70 | 700 | 50 | 50 | N | <50 | 100 | 150 | N | 10 | N | 500 | 200 | N |
| 140 | WIH6901P | N | N | 50 | 1,500 | 50 | <50 | N | 50 | 200 | 70 | N | 15 | <20 | 500 | 500 | N |
| 141 | WIH6902P | N | N | 20 | 200 | 50 | N | N | N | 50 | 70 | N | N | N | N | 700 | <100 |
| 142 | WIH6905P | N | N | 20 | 700 | 50 | 70 | N | <50 | 150 | 30 | N | 15 | N | 1,000 | 300 | N |
| 143 | WIH7954P | N | N | 20 | 500 | 30 | 100 | N | <50 | 150 | 30 | N | 20 | N | 1,000 | 100 | N |
| 144 | WIH7956P | N | N | 20 | 500 | 50 | 70 | N | N | 150 | 30 | N | 20 | N | 1,000 | 200 | N |
| 145 | WIH7958P | N | N | 10 | 200 | 15 | 70 | N | N | 100 | 30 | N | 10 | N | 1,000 | 100 | N |
| 146 | WIH7960P | N | N | 50 | 500 | 100 | 70 | N | N | 150 | 50 | N | 15 | N | 1,500 | 300 | N |
| 147 | WIH7962P | N | N | 20 | 1,500 | 30 | 70 | N | <50 | 150 | <20 | N | 20 | N | 1,000 | 150 | N |
| 148 | WIH7964P | N | N | 20 | 300 | 30 | 50 | N | N | 100 | 50 | N | 10 | N | 700 | 150 | N |
| 149 | WIH7966P | N | N | 15 | 150 | 50 | 70 | N | N | 70 | 20 | N | 10 | N | 700 | 150 | N |
| 150 | WIH7968P | N | N | 20 | 300 | 70 | 100 | N | N | 150 | 30 | N | 20 | N | 700 | 300 | N |
| 151 | WIH7970P | N | N | 30 | 700 | 70 | 100 | N | <50 | 150 | 70 | N | 15 | N | 1,000 | 300 | N |
| 152 | WIH7972P | N | N | 15 | 300 | 30 | 70 | N | N | 70 | 50 | N | 15 | N | 1,000 | 150 | N |
| 153 | WIH7974P | N | N | 15 | 200 | 20 | 70 | N | N | 70 | 50 | N | 15 | N | 1,500 | 100 | N |
| 154 | WIH7976P | N | N | 15 | 100 | <10 | 100 | N | N | 30 | 50 | N | <10 | N | 1,000 | 150 | N |
| 155 | WIH7978P | N | N | 20 | 200 | 10 | 100 | N | N | 50 | 30 | N | 10 | N | 1,000 | 150 | N |

| MAP # | SAMPLE | S-Y | S-ZN | S-ZR | S-TH | AA-AU |
|---|---|---|---|---|---|---|
| 135 | WIH5828P | N | N | 150 | N | <.050 |
| 136 | WIH5861P | N | N | 500 | N | <.050 |
| 137 | WIH5863P | 30 | <500 | 700 | N | 1.680 |
| 138 | WIH5865P | <20 | N | 500 | N | 1.140 |
| 139 | WIH5971P | <20 | N | 500 | N | .050 |
| 140 | WIH6901P | <20 | N | 700 | N | 2.400 |
| 141 | WIH6902P | 20 | N | 700 | N | 46.300 |
| 142 | WIH6905P | N | N | 150 | N | <.050 |
| 143 | WIH7954P | 30 | N | 700 | N | N |
| 144 | WIH7956P | <20 | N | 700 | N | N |
| 145 | WIH7958P | <20 | N | 500 | N | N |
| 146 | WIH7960P | <20 | N | 300 | N | N |
| 147 | WIH7962P | 50 | N | 700 | N | N |
| 148 | WIH7964P | <20 | N | 700 | N | N |
| 149 | WIH7966P | 30 | N | 500 | N | N |
| 150 | WIH7968P | 70 | N | 700 | N | N |
| 151 | WIH7970P | 30 | N | 1,500 | N | N |
| 152 | WIH7972P | 30 | N | 700 | N | N |
| 153 | WIH7974P | 30 | N | 200 | N | N |
| 154 | WIH7976P | 30 | N | 300 | N | N |
| 155 | WIH7978P | 50 | N | 700 | N | N |

# CHAPTER C

## LATITUDE 46°30'-47°00' LONGITUDE 113°00'-113°30'

## BLE 3, STREAM-SEDIMENT SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1°X2° CUSMAP QUADRANGLE, MONTANA (continued)

| # | SAMPLE | LATITUDE | LONGITUDE | S-FE% | S-MG% | S-CA% | S-TI% | S-MN | S-AG | S-AS | S-AU | S-B | S-BA | S-BE | S-BI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 156 | BAT7848S | 46 52 43 | 113 20 34 | 5.0 | 1.5 | 3.00 | .50 | 1,500 | N | N | N | 50 | 300 | 2.0 | N |
| 157 | BAT7853S | 46 52 47 | 113 22 9 | 7.0 | 3.0 | 3.00 | .50 | 1,500 | N | N | N | 20 | >5,000 | 1.5 | N |
| 158 | BAT7854S | 46 53 50 | 113 21 47 | 3.0 | 1.5 | .70 | .30 | 700 | N | N | N | 30 | 1,500 | 2.0 | N |
| 159 | BAT7856S | 46 53 54 | 113 21 44 | 2.0 | .5 | .50 | .30 | 300 | N | N | N | 100 | 700 | 1.5 | N |
| 160 | BAT7858S | 46 53 6 | 113 18 35 | 7.0 | 1.5 | 3.00 | 1.00 | 1,500 | N | N | N | 30 | 300 | 1.5 | N |
| 161 | BAT7860S | 46 54 20 | 113 16 10 | 7.0 | 1.5 | 3.00 | .70 | 1,500 | N | N | N | 20 | 300 | 2.0 | N |
| 162 | BAT7862S | 46 53 23 | 113 15 22 | 3.0 | .7 | 1.50 | .30 | 5,000 | N | N | N | 30 | 500 | 2.0 | N |
| 163 | BAT7863S | 66 56 13 | 113 15 34 | 1.5 | .7 | .70 | .20 | 300 | N | N | N | 100 | 500 | 5.0 | N |
| 164 | BAT7865S | 46 59 4 | 113 15 9 | 3.0 | 1.0 | .30 | .30 | 500 | N | N | N | 150 | 1,000 | 2.0 | N |
| 165 | BAT7867S | 46 57 16 | 113 16 11 | 3.0 | .7 | .70 | .30 | 1,500 | <.5 | N | N | 50 | 500 | 7.0 | N |
| 166 | BAT7868S | 46 58 28 | 113 16 11 | 3.0 | .7 | .70 | .30 | 1,500 | 5.0 | N | N | 150 | 700 | 3.0 | N |
| 167 | BAT7870S | 46 58 43 | 113 16 56 | 3.0 | 1.0 | .30 | .50 | 1,500 | N | N | N | 150 | 500 | 2.0 | N |
| 168 | BAT7872S | 46 58 41 | 113 16 58 | 3.0 | 1.0 | .30 | .50 | 1,500 | N | N | N | 150 | 500 | 2.0 | N |
| 169 | BAT7875S | 46 57 15 | 113 21 39 | 3.0 | .7 | .50 | .50 | 1,000 | N | N | N | 200 | 700 | 2.0 | N |
| 170 | BAT7876S | 46 57 4 | 113 21 2 | 3.0 | .7 | .50 | .30 | 500 | N | N | N | 150 | 700 | 3.0 | N |
| 171 | BAT7877S | 46 55 52 | 113 22 6 | 2.0 | .7 | .70 | .30 | 1,000 | N | N | N | 100 | 700 | 2.0 | N |
| 172 | BAT7878S | 46 54 20 | 113 20 11 | 1.5 | .7 | .50 | .30 | 300 | N | N | N | 200 | 500 | 1.5 | N |
| 173 | BAT7880S | 46 55 23 | 113 20 35 | 2.0 | 2.0 | .70 | .30 | 700 | N | N | N | 200 | 500 | 5.0 | N |
| 174 | BAT7882S | 46 55 23 | 113 20 30 | 3.0 | 1.5 | .70 | .30 | 500 | N | N | N | 100 | 300 | 2.0 | N |
| 175 | BAT7884S | 46 56 2 | 113 20 39 | 3.0 | .7 | .70 | .50 | 700 | N | N | N | 150 | 700 | 2.0 | N |
| 176 | BAT7886S | 46 58 29 | 113 19 21 | 3.0 | 1.5 | 2.00 | .20 | 700 | N | N | N | 30 | 1,500 | 2.0 | N |
| 177 | BAT7888S | 46 57 34 | 113 18 47 | 3.0 | 1.0 | 2.00 | .50 | 700 | N | N | N | 30 | 1,500 | 1.5 | N |
| 178 | BAT7890S | 46 57 15 | 113 17 44 | 3.0 | 1.0 | .70 | .50 | 1,000 | N | N | N | 200 | 700 | 2.0 | N |
| 179 | BAT7892S | 46 55 17 | 113 16 48 | 1.5 | .5 | .70 | .30 | 500 | <.5 | N | N | 50 | 300 | 5.0 | N |
| 180 | BAT7893S | 46 55 18 | 113 16 48 | 3.0 | 1.0 | .50 | .50 | 1,000 | N | N | N | 150 | 700 | 2.0 | N |
| 181 | BEM3433S | 46 42 51 | 113 15 30 | 5.0 | 1.5 | 2.00 | .70 | 1,000 | <.5 | N | N | 100 | 1,000 | 2.0 | N |
| 182 | BEM4887S | 46 44 13 | 113 20 52 | 2.0 | 1.0 | 5.00 | .30 | 700 | N | N | N | 150 | 700 | 5.0 | N |
| 183 | BEM4888S | 46 44 53 | 113 21 53 | 1.5 | 1.5 | 3.00 | .30 | 1,000 | N | N | N | 70 | 2,000 | 3.0 | N |
| 184 | BEM4889S | 46 44 34 | 113 20 26 | 2.0 | .5 | 3.00 | .30 | 1,000 | N | N | N | 150 | 700 | 3.0 | N |
| 185 | BEM5805S | 46 43 30 | 113 17 35 | 3.0 | 1.0 | 2.00 | .30 | 300 | <.5 | N | N | 150 | 1,000 | 1.5 | N |
| 186 | BEM5806S | 46 43 30 | 113 17 32 | 3.0 | 1.5 | 15.00 | .30 | 700 | N | N | N | 150 | 1,000 | 2.0 | N |
| 187 | BEM5807S | 46 44 39 | 113 16 32 | 3.0 | 3.0 | 15.00 | .20 | 1,000 | N | N | N | 150 | 500 | 2.0 | N |
| 188 | BEM5808S | 46 44 37 | 113 16 25 | 3.0 | 5.0 | 15.00 | .20 | 700 | N | N | N | 150 | 500 | 1.5 | N |
| 189 | BEM5809S | 46 44 8 | 113 16 16 | 3.0 | .7 | 2.00 | .30 | 1,000 | N | N | N | 200 | 500 | 2.0 | N |
| 190 | BEM5810S | 46 43 13 | 113 16 39 | 5.0 | 1.5 | 2.00 | .50 | 1,000 | N | N | N | 150 | 1,000 | 1.5 | N |
| 191 | BEM5811S | 46 43 11 | 113 15 57 | 3.0 | 1.0 | 7.00 | .30 | 1,000 | N | N | N | 150 | 1,000 | 1.5 | N |
| 192 | BEM5937S | 46 42 1 | 113 15 18 | 3.0 | .7 | 3.00 | .50 | 1,000 | N | 200 | N | 200 | 700 | 3.0 | N |
| 193 | BR07986S | 46 52 31 | 113 5 39 | 5.0 | 1.5 | 2.00 | .50 | 2,000 | N | N | N | 10 | 2,000 | 1.5 | N |
| 194 | BR08837S | 46 55 8 | 113 1 42 | 2.0 | .7 | .50 | .20 | 700 | N | N | N | 70 | 300 | 2.0 | N |
| 195 | BR08838S | 46 55 8 | 113 1 27 | 2.0 | 1.5 | 1.00 | .30 | 500 | N | N | N | 70 | 300 | 2.0 | N |
| 196 | BR08839S | 46 56 20 | 113 7 28 | 1.5 | .7 | .70 | .20 | 700 | N | N | N | 70 | 500 | 1.5 | N |
| 197 | BR08841S | 46 55 40 | 113 6 48 | 3.0 | 1.0 | 1.50 | .20 | 500 | N | N | N | 30 | 300 | 1.5 | N |
| 198 | BR08843S | 46 55 41 | 113 6 37 | 3.0 | 1.0 | .70 | >1.00 | 500 | N | N | N | 70 | 500 | 1.5 | N |
| 199 | BR08845S | 46 53 49 | 113 4 5 | 3.0 | 1.5 | .70 | .30 | 300 | N | N | N | 100 | 700 | 2.0 | N |

LATITUDE 46°30'-47°00' LONGITUDE 113°00'-113°30'

ABLE 3. STREAM-SEDIMENT SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1°X2° CUSMAP QUADRANGLE, MONTANA (continued

| MAP # | SAMPLE | S-CD | S-CO | S-CR | S-CU | S-LA | S-MO | S-NB | S-NI | S-PB | S-SB | S-SC | S-SN | S-SR | S-V | S-W | S-Y | S-ZN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 156 | BAT7848S | N | 10 | 30 | 15 | 50 | N | <20 | 10 | 20 | N | 15 | N | 500 | 100 | N | 50 | N |
| 157 | BAT7853S | N | 15 | 70 | 50 | 30 | N | N | 20 | 30 | N | 15 | N | 500 | 150 | N | 30 | N |
| 158 | BAT7854S | N | 10 | 50 | 30 | 30 | N | N | 15 | 20 | N | 10 | N | 100 | 20 | N | 50 | N |
| 159 | BAT7856S | N | 5 | 30 | 15 | 20 | N | <20 | 7 | 20 | N | 5 | N | <100 | 20 | N | 20 | N |
| 160 | BAT7858S | N | 10 | 50 | 30 | 70 | N | <20 | 10 | 20 | N | 15 | N | 300 | 150 | N | 100 | N |
| 161 | BAT7860S | N | 10 | 50 | 20 | 50 | N | <20 | 10 | 30 | N | 15 | N | 500 | 150 | N | 70 | N |
| 162 | BAT7862S | N | 20 | 50 | 15 | 30 | 5 | N | 10 | 15 | N | 7 | N | 200 | 150 | N | 30 | N |
| 163 | BAT7863S | N | 5 | 30 | 20 | 30 | N | N | 10 | 10 | N | 5 | N | N | 30 | N | 50 | N |
| 164 | BAT7865S | N | 7 | 50 | 30 | 30 | N | N | 20 | 15 | N | 7 | N | N | 50 | N | 30 | N |
| 165 | BAT7867S | N | 10 | 30 | 70 | 200 | N | N | 30 | 30 | N | 10 | N | N | 70 | N | 150 | N |
| 166 | BAT7868S | N | 10 | 70 | 30 | 50 | N | <20 | 30 | 20 | N | 10 | N | <100 | 70 | N | 70 | N |
| 167 | BAT7870S | N | 10 | 70 | 30 | 50 | N | <20 | 30 | 30 | N | 10 | N | N | 70 | N | 30 | N |
| 168 | BAT7872S | N | 10 | 30 | 30 | 30 | N | N | 30 | 30 | N | 7 | N | N | 70 | N | 30 | N |
| 169 | BAT7875S | N | 10 | 30 | 30 | 30 | N | N | 20 | 30 | N | 7 | N | <100 | 70 | N | 20 | N |
| 170 | BAT7876S | N | 7 | 30 | 70 | 30 | N | N | 30 | 30 | N | 7 | N | <100 | 50 | N | 30 | N |
| 171 | BAT7877S | N | 7 | 20 | 20 | 30 | N | N | 15 | 20 | N | 7 | N | 100 | 50 | N | 20 | N |
| 172 | BAT7878S | N | 7 | 30 | 10 | 30 | N | N | 5 | 10 | N | 5 | N | N | 30 | N | 20 | N |
| 173 | BAT7880S | N | 7 | 30 | 20 | 50 | N | N | 20 | 15 | N | 5 | N | <100 | 50 | N | 30 | N |
| 174 | BAT7882S | N | 7 | 50 | 30 | 30 | N | N | 30 | 20 | N | 5 | N | <100 | 50 | N | 30 | N |
| 175 | BAT7884S | N | 10 | 50 | 30 | 30 | N | N | 30 | 20 | N | 7 | N | <100 | 70 | N | 50 | N |
| 176 | BAT7886S | N | 10 | 70 | 30 | 30 | N | N | 50 | 30 | N | 5 | N | 1,000 | 50 | N | 15 | N |
| 177 | BAT7888S | N | 10 | 30 | 30 | 150 | N | N | 20 | 30 | N | 7 | N | 1,500 | 70 | N | 20 | N |
| 178 | BAT7890S | N | 10 | 50 | 50 | 100 | N | <20 | 30 | 30 | N | 7 | N | 100 | 70 | N | 50 | N |
| 179 | BAT7892S | N | 7 | 50 | 20 | 30 | N | <20 | 15 | 20 | N | 10 | N | <100 | 70 | N | 50 | N |
| 180 | BAT7893S | N | 10 | 70 | 30 | 30 | N | <20 | 15 | 30 | N | 10 | N | 100 | 100 | N | 30 | N |
| 181 | BEM3433S | N | 15 | 100 | 70 | 30 | N | N | 70 | 20 | N | 15 | N | 200 | 200 | N | 30 | <200 |
| 182 | BEM4887S | N | 5 | 50 | 20 | 30 | N | <20 | 15 | 50 | N | 7 | N | <100 | 70 | N | 20 | N |
| 183 | BEM4888S | N | 7 | 50 | 15 | 30 | N | <20 | 20 | 50 | N | 5 | N | 300 | 50 | N | 20 | N |
| 184 | BEM4889S | N | 5 | 70 | 30 | 50 | N | <20 | 15 | 50 | N | 7 | N | <100 | 50 | N | 30 | N |
| 185 | BEM5805S | N | 10 | 100 | 30 | 50 | N | <20 | 30 | 30 | N | 7 | N | 200 | 100 | N | 20 | N |
| 186 | BEM5806S | N | 7 | 100 | 50 | 50 | N | <20 | 30 | 30 | N | 10 | N | 300 | 100 | N | 20 | N |
| 187 | BEM5807S | N | 7 | 70 | 20 | 50 | N | <20 | 30 | 50 | N | 5 | N | 150 | 70 | N | 20 | N |
| 188 | BEM5808S | N | 7 | 70 | 20 | 30 | N | <20 | 30 | 50 | N | 5 | N | 150 | 50 | N | 20 | N |
| 189 | BEM5809S | N | 10 | 150 | 30 | 50 | N | <20 | 30 | 30 | N | 10 | N | <100 | 70 | N | 20 | N |
| 190 | BEM5810S | N | 10 | 100 | 50 | 50 | N | <20 | 50 | 30 | N | 15 | N | 150 | 150 | N | 30 | <200 |
| 191 | BEM5811S | N | 10 | 100 | 50 | 50 | N | <20 | 50 | 30 | N | 10 | N | 300 | 100 | N | 20 | N |
| 192 | BEM5937S | N | 7 | 100 | 30 | 50 | N | <20 | 30 | 30 | N | 10 | N | <100 | 100 | N | 30 | N |
| 193 | BRO7986S | N | 15 | 150 | 50 | 70 | N | <20 | 100 | 30 | N | 10 | N | 1,000 | 100 | N | 20 | N |
| 194 | BRO8837S | N | 7 | 20 | 30 | 30 | N | N | 15 | 30 | N | 7 | N | 100 | 70 | N | 20 | N |
| 195 | BRO8838S | N | 7 | 50 | 30 | 50 | N | <20 | 20 | 30 | N | 10 | N | 100 | 70 | N | 30 | N |
| 196 | BRO8839S | N | 5 | 20 | 20 | 30 | N | N | 10 | 20 | N | 7 | N | 150 | 70 | N | 15 | N |
| 197 | BRO8841S | N | 7 | 30 | 20 | 30 | N | N | 15 | 30 | N | 10 | N | 500 | 70 | N | 30 | N |
| 198 | BRO8843S | N | 7 | 30 | 15 | 70 | N | <20 | 10 | 20 | N | 7 | N | 150 | 100 | N | 30 | N |
| 199 | BRO8845S | N | 10 | 50 | 30 | 50 | N | <20 | 20 | 30 | N | 7 | N | 200 | 70 | N | 30 | N |

| [illegible] | SAMPLE | S-ZR | S-TH | AA-CU | AA-PB | AA-ZN | AA-AG | AA-CD | AA-[illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|
| 156 | BAT7848S | 300 | N | 3.0 | 3.0 | 13.0 | <.05 | .15 | 1.0 | <1 |
| 157 | BAT7853S | 300 | N | 23.0 | 5.0 | 13.0 | <.05 | .15 | 1.0 | <1 |
| 158 | BAT7854S | 150 | N | 16.0 | 7.0 | 23.0 | .09 | .25 | 1.0 | <1 |
| 159 | BAT7856S | 500 | N | 9.0 | 8.0 | 19.0 | <.05 | .15 | 1.0 | 1 |
| 160 | BAT7858S | 200 | N | 2.0 | 3.0 | 7.0 | <.05 | .15 | 1.0 | <1 |
| 161 | BAT7860S | 500 | N | 5.0 | 4.0 | 7.0 | <.05 | .15 | 1.0 | <1 |
| 162 | BAT7862S | 150 | N | 7.0 | 10.0 | 57.0 | .09 | .60 | <1.0 | <1 |
| 163 | BAT7863S | 150 | N | 9.0 | 7.0 | 6.0 | .16 | .10 | <1.0 | <1 |
| 164 | BAT7865S | 200 | N | 15.0 | 8.0 | 9.0 | .07 | .10 | <1.0 | <1 |
| 165 | BAT7867S | 150 | N | 106.0 | 33.0 | 20.0 | .70 | .65 | <1.0 | <1 |
| 166 | BAT7868S | 300 | N | 32.0 | 21.0 | 15.0 | .10 | .25 | <1.0 | <1 |
| 167 | BAT7870S | 300 | N | 26.0 | 26.0 | 21.0 | .10 | .20 | <1.0 | <1 |
| 168 | BAT7872S | 150 | N | 18.0 | 22.0 | 23.0 | .10 | .25 | <1.0 | <1 |
| 169 | BAT7875S | 300 | N | 15.0 | 23.0 | 36.0 | <.05 | .35 | <1.0 | <1 |
| 170 | BAT7876S | 200 | N | 64.0 | 24.0 | 35.0 | .28 | .35 | <1.0 | 1 |
| 171 | BAT7877S | 200 | N | 9.0 | 9.0 | 9.0 | .07 | .30 | 2.0 | <1 |
| 172 | BAT7878S | >1,000 | N | 3.0 | 3.0 | 2.0 | .12 | .08 | 1.0 | <1 |
| 173 | BAT7880S | 200 | N | 6.0 | 5.0 | 6.0 | <.05 | .10 | 1.0 | <1 |
| 174 | BAT7882S | 200 | N | 17.0 | 10.0 | 9.0 | .16 | .20 | 2.0 | 1 |
| 175 | BAT7884S | 200 | N | 22.0 | 10.0 | 11.0 | .09 | .20 | 2.0 | 1 |
| 176 | BAT7886S | 100 | N | 17.0 | 13.0 | 43.0 | .20 | .30 | 1.0 | 1 |
| 177 | BAT7888S | 150 | N | 11.0 | 5.0 | 9.0 | .08 | .15 | 1.0 | 1 |
| 178 | BAT7890S | 300 | N | 27.0 | 11.0 | 13.0 | .12 | .20 | 2.0 | 1 |
| 179 | BAT7892S | 200 | N | 17.0 | 23.0 | 12.0 | .33 | .55 | <1.0 | 1 |
| 180 | BAT7893S | 300 | N | 10.0 | 22.0 | 11.0 | .14 | .25 | <1.0 | <1 |
| 181 | BEM3433S | 150 | N | 15.0 | 7.0 | 9.0 | .14 | .55 | <1.0 | N |
| 182 | BEM4887S | 150 | N | 20.0 | 29.0 | 44.0 | .17 | .54 | 2.0 | 4 |
| 183 | BEM4888S | 200 | N | 6.0 | 13.0 | 10.0 | .11 | .32 | 2.0 | 4 |
| 184 | BEM4889S | 200 | N | 26.0 | 30.0 | 47.0 | .22 | .78 | 2.0 | 5 |
| 185 | BEM5805S | 300 | N | 5.0 | 6.0 | 16.0 | .11 | .45 | 1.0 | <1 |
| 186 | BEM5806S | 200 | N | 20.0 | 9.0 | 18.0 | .18 | 1.00 | 3.0 | 3 |
| 187 | BEM5807S | 100 | N | 11.0 | 16.0 | 50.0 | .17 | .75 | 3.0 | 6 |
| 188 | BEM5808S | 100 | N | 8.0 | 17.0 | 18.0 | .17 | .62 | N | 5 |
| 189 | BEM5809S | 150 | N | 11.0 | 14.0 | 26.0 | .18 | .87 | N | 3 |
| 190 | BEM5810S | 200 | N | 17.0 | 9.0 | 17.0 | .06 | .67 | 1.0 | N |
| 191 | BEM5811S | 100 | N | 20.0 | 11.0 | 16.0 | .09 | .60 | 2.0 | <1 |
| 192 | BEM5937S | 300 | N | 16.0 | 14.0 | 28.0 | .10 | .45 | 1.0 | 3 |
| 193 | BRO7986S | 300 | N | 12.0 | 10.0 | 47.0 | .14 | .28 | <1.0 | <1 |
| 194 | BRO8837S | 150 | N | 18.0 | 13.0 | 16.0 | .09 | .20 | <1.0 | <1 |
| 195 | BRO8838S | 200 | N | 19.0 | 12.0 | 13.0 | .08 | .25 | <1.0 | <1 |
| 196 | BRO8839S | 150 | N | 5.0 | 4.0 | 6.0 | <.05 | .05 | <1.0 | <1 |
| 197 | BRO8841S | 200 | N | 4.0 | 3.0 | 6.0 | <.05 | .05 | <1.0 | <1 |
| 198 | BRO8843S | 300 | N | 2.0 | 3.0 | 5.0 | <.05 | .05 | <1.0 | <1 |
| 199 | BRO8845S | 200 | N | 14.0 | 13.0 | 15.0 | .08 | .20 | <1.0 | <1 |

LATITUDE 46°30'-47°00' LONGITUDE 112°30'-113°00'

TABLE 2.PAN-CONCENTRATE SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1°x2° CUSMAP QUADRANGLE, MONTANA(continued)

| | SAMPLE | LATITUDE | LONGITUDE | S-FEX | S-MGX | S-CAX | S-TIX | S-MN | S-AG | S-AS | S-AU | S-B | S-BA | S-BE | S-BI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 200 | GA5741P | 46 43 20 | 112 53 17 | 3.00 | 1.50 | .70 | .500 | 3,000 | N | N | N | 50 | 3,000 | 3 | N |
| 201 | GA5743P | 46 43 15 | 112 53 17 | 5.00 | 1.00 | 2.00 | .700 | 500 | N | N | N | N | 5,000 | <2 | N |
| 202 | GA5745P | 46 43 15 | 112 53 17 | 5.00 | 1.50 | 2.00 | .700 | 2,000 | N | N | N | N | 3,000 | 2 | N |
| 203 | GA5747P | 46 44 29 | 112 50 46 | 3.00 | .70 | 1.50 | .500 | 1,000 | N | N | N | N | 3,000 | 2 | N |
| 204 | GA5749P | 46 41 44 | 112 51 42 | 7.00 | 2.00 | 3.00 | 1.000 | 1,500 | N | N | N | <20 | 2,000 | 2 | N |
| 205 | GA8858P | 46 43 35 | 112 47 49 | 7.00 | 1.50 | 1.50 | .700 | 1,000 | N | N | N | 20 | 2,000 | 3 | N |
| 206 | GA8860P | 46 43 28 | 112 47 57 | 3.00 | 1.50 | 2.00 | 1.000 | 700 | N | N | N | 30 | 3,000 | <2 | N |
| 207 | GA8862P | 46 43 27 | 112 47 43 | 2.00 | 1.50 | 3.00 | .700 | 700 | N | N | N | N | 3,000 | 2 | N |
| 208 | GA8920P | 46 44 16 | 112 59 29 | 7.00 | 1.50 | .30 | .500 | 2,000 | N | N | N | 300 | 1,000 | 3 | N |
| 209 | GA8922P | 46 44 16 | 112 59 3 | 3.00 | .70 | 2.00 | .500 | 2,000 | N | N | N | N | 3,000 | 3 | N |
| 210 | GA8924P | 46 44 8 | 112 58 59 | 5.00 | .70 | 2.00 | .500 | 3,000 | N | N | N | N | 3,000 | 3 | N |
| 211 | HLM6613P | 46 50 38 | 112 53 50 | 30.00 | 2.00 | 3.00 | 1.000 | 3,000 | N | N | N | N | 2,000 | N | N |
| 212 | HLM6615P | 46 49 29 | 112 53 0 | 5.00 | 1.00 | .70 | .700 | 700 | N | N | N | 200 | 2,000 | 2 | N |
| 213 | HLM6617P | 46 49 32 | 112 53 36 | 5.00 | .50 | .70 | .700 | 700 | N | N | N | 70 | 1,500 | 2 | N |
| 214 | HLM6619P | 46 49 34 | 112 54 2 | 1.50 | .30 | .70 | .300 | 150 | N | N | N | 70 | 2,000 | 3 | N |
| 215 | HLM6622P | 46 50 50 | 112 58 28 | 3.00 | .70 | 2.00 | 1.000 | 1,000 | N | N | N | 20 | 1,500 | 2 | N |
| 216 | HLM6624P | 46 50 20 | 112 57 3 | 3.00 | .70 | 2.00 | .700 | 700 | N | N | N | 20 | 7,000 | 2 | N |
| 217 | HLM6628P | 46 47 20 | 112 59 19 | 5.00 | 1.00 | .50 | .700 | 1,000 | N | N | N | 150 | 7,000 | 3 | N |
| 218 | HLM6630P | 46 47 20 | 112 59 13 | 3.00 | .70 | .70 | .500 | 700 | N | N | N | 150 | 3,000 | 3 | N |
| 219 | NLK5739P | 46 46 38 | 112 59 13 | 3.00 | 1.50 | 2.00 | .700 | 500 | N | N | N | N | 3,000 | 2 | N |
| 220 | NLK8903P | 46 43 32 | 112 47 47 | 5.00 | 1.00 | 2.00 | 1.000 | 500 | N | N | N | 20 | 3,000 | 2 | N |
| 221 | NLK8905P | 46 46 40 | 112 47 53 | 3.00 | .50 | 1.00 | .500 | 1,000 | N | N | N | N | 2,000 | 3 | N |
| 222 | NLK8907P | 46 46 43 | 112 47 59 | 3.00 | 1.50 | 2.00 | .700 | 1,000 | N | N | N | N | 3,000 | <2 | N |
| 223 | NLK8909P | 46 48 23 | 112 50 30 | 3.00 | .70 | .30 | .500 | 1,000 | N | N | N | 200 | 1,000 | 3 | N |
| 224 | NLK8911P | 46 48 22 | 112 50 20 | 3.00 | 1.00 | 1.00 | .700 | 1,000 | N | N | N | 100 | 2,000 | 2 | N |
| 225 | NLK8914P | 46 48 51 | 112 51 19 | 3.00 | .30 | .20 | .500 | 200 | N | N | N | 100 | 1,500 | 2 | N |
| 226 | NLK8916P | 46 46 32 | 112 46 3 | 1.50 | .30 | 1.50 | .500 | 300 | N | N | N | N | 3,000 | 2 | N |
| 227 | NLK8918P | 46 46 12 | 112 45 26 | 1.50 | .70 | 2.00 | .700 | 1,500 | N | N | N | N | 2,000 | 2 | N |

LATITUDE 46°30'–47°00' LONGITUDE 112°30'–113°00'

TABLE 2.PAN-CONCENTRATE SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1°x2°CUSMAP QUADRANGLE, MONTANA(continued)

| MAP # | SAMPLE | S-CD | S-CO | S-CR | S-CU | S-LA | S-MO | S-NB | S-NI | S-PB | S-SB | S-SC | S-SN | S-SR | S-V | S-W | S-Y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 200 | GA5741P | N | 15 | 100 | 20 | 70 | N | N | 30 | 50 | N | 10 | N | 700 | 70 | N | 20 |
| 201 | GA5743P | N | 30 | 200 | 30 | 70 | N | N | 70 | 70 | N | 10 | N | 1,500 | 300 | N | 50 |
| 202 | GA5745P | N | 20 | 150 | 30 | 100 | N | N | 70 | 70 | N | 10 | N | 1,500 | 100 | N | <20 |
| 203 | GA5747P | N | 10 | 100 | <10 | 100 | N | N | 30 | 50 | N | <10 | N | 1,500 | 50 | N | N |
| 204 | GA5749P | N | 15 | 200 | 50 | 70 | N | N | 70 | 50 | N | 10 | N | 1,000 | 100 | N | 20 |
| 205 | GA8858P | N | 10 | 200 | 20 | 70 | N | N | 70 | 50 | N | 10 | N | 700 | 200 | N | <20 |
| 206 | GA8860P | N | 10 | 100 | 15 | 150 | N | N | 20 | 30 | N | 10 | N | 1,500 | 70 | N | <20 |
| 207 | GA8862P | N | 10 | 70 | <10 | 70 | N | N | 15 | 30 | N | <10 | N | 3,000 | 70 | N | <20 |
| 208 | GA8920P | N | 15 | 150 | 50 | 70 | N | N | 70 | 200 | N | 10 | N | <200 | 200 | N | 20 |
| 209 | GA8922P | N | 15 | 70 | 15 | 100 | N | N | 50 | 70 | N | <10 | N | 1,500 | 100 | N | N |
| 210 | GA8924P | N | 15 | 100 | 15 | 100 | N | N | 70 | 70 | N | <10 | N | 2,000 | 100 | N | <20 |
| 211 | HLM6613P | N | 70 | 1,500 | 200 | <50 | N | N | 150 | 100 | N | 15 | N | <200 | 1,500 | N | 50 |
| 212 | HLM6615P | N | 10 | 150 | 10 | 70 | N | <50 | 15 | 50 | N | <10 | N | 300 | 150 | N | 150 |
| 213 | HLM6617P | N | <10 | 300 | <10 | 150 | N | N | 10 | 30 | N | <10 | N | 200 | 150 | N | 50 |
| 214 | HLM6619P | N | N | 30 | <10 | 70 | N | N | 10 | 30 | N | <10 | N | 200 | 50 | N | 30 |
| 215 | HLM6622P | N | N | 100 | <10 | 500 | N | <50 | 10 | 30 | N | <10 | N | 300 | 150 | N | 70 |
| 216 | HLM6624P | N | 10 | 70 | 10 | 500 | N | N | 10 | 20 | N | <10 | N | 500 | 150 | N | 70 |
| 217 | HLM6628P | N | 15 | 150 | 30 | 70 | N | N | 50 | 30 | N | 10 | N | <200 | 150 | N | 50 |
| 218 | HLM6630P | N | 10 | 100 | 10 | 50 | N | N | 20 | 50 | N | <10 | N | 300 | 70 | N | 30 |
| 219 | NLK5739P | N | 10 | 100 | 10 | <50 | N | N | 50 | 30 | N | <10 | N | 1,500 | 70 | N | N |
| 220 | NLK8903P | N | 10 | 700 | 10 | 100 | N | <50 | 50 | 30 | N | <10 | N | 2,000 | 100 | N | 50 |
| 221 | NLK8905P | N | 10 | 50 | 10 | 50 | N | N | 30 | 50 | N | <10 | N | 1,000 | 70 | N | <20 |
| 222 | NLK8907P | N | 15 | 300 | 15 | 50 | N | N | 70 | 30 | N | 10 | N | 2,000 | 100 | N | <20 |
| 223 | NLK8909P | N | 10 | 50 | <10 | 50 | N | N | 30 | 30 | N | <10 | N | 200 | 70 | N | 20 |
| 224 | NLK8911P | N | 15 | 100 | 10 | 70 | N | N | 50 | 30 | N | <10 | N | 700 | 70 | N | 30 |
| 225 | NLK8914P | N | <10 | 200 | <10 | 50 | N | N | <10 | 20 | N | 10 | 30 | N | 50 | N | 30 |
| 226 | NLK8916P | N | N | 70 | 10 | 70 | N | N | 10 | 70 | N | <10 | N | 1,000 | 20 | N | 20 |
| 227 | NLK8918P | N | N | 50 | <10 | 70 | N | N | 15 | 50 | N | N | N | 1,000 | 30 | N | <20 |

| # | SAMPLE | S-ZN | S-ZR | S-TH | AA-AU |
|---|---|---|---|---|---|
| 200 | GA5741P | N | 300 | N | <.05 |
| 201 | GA5743P | N | 300 | N | <.05 |
| 202 | GA5745P | N | 300 | N | <.05 |
| 203 | GA5747P | N | 200 | N | <.05 |
| 204 | GA5749P | N | 300 | N | <.05 |
| 205 | GA8858P | N | 300 | N | <.05 |
| 206 | GA8860P | N | 2,000 | N | <.05 |
| 207 | GA8862P | N | 70 | N | <.05 |
| 208 | GA8920P | N | N | N | <.05 |
| 209 | GA8922P | N | 300 | N | <.05 |
| 210 | GA8924P | N | 300 | N | <.05 |
| 211 | HLM6613P | N | 700 | N | <.05 |
| 212 | HLM6615P | N | >2,000 | N | .15 |
| 213 | HLM6617P | N | >2,000 | N | <.05 |
| 214 | HLM6619P | N | >2,000 | N | <.05 |
| 215 | HLM6622P | N | 700 | N | .09 |
| 216 | HLM6624P | N | 1,500 | N | .27 |
| 217 | HLM6628P | N | 700 | N | <.05 |
| 218 | HLM6630P | N | 300 | N | <.05 |
| 219 | NLK5739P | N | 300 | N | <.05 |
| 220 | NLK8903P | N | >2,000 | N | N |
| 221 | NLK8905P | N | 300 | N | N |
| 222 | NLK8907P | N | 700 | N | N |
| 223 | NLK8909P | N | 700 | N | N |
| 224 | NLK8911P | N | 100 | N | N |
| 225 | NLK8914P | N | >2,000 | N | N |
| 226 | NLK8916P | N | 1,000 | N | N |
| 227 | NLK8918P | N | 300 | N | N |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 228 | BUN3127S | 46 40 51 | 112 58 2 | 3.0 | .7 | 1.5 | .30 | 1,000 | 1.0 | N | N | 50 | 500 | [illegible] | [illegible] | [illegible] |
| 229 | GA3127S | 46 41 12 | 112 56 48 | 3.0 | 1.0 | 1.5 | .50 | 700 | N | N | N | 100 | 500 | 1.5 | N | N |
| 230 | GA3131S | 46 40 55 | 112 58 4 | 3.0 | 1.0 | .7 | .50 | 500 | N | N | N | 150 | 1,500 | 1.5 | N | N |
| 231 | GA3132S | 46 41 27 | 112 56 45 | 1.5 | .3 | 1.0 | .30 | 700 | N | N | N | 70 | 500 | 2.0 | N | N |
| 232 | GA3134S | 46 42 31 | 112 59 41 | 3.0 | 2.0 | 5.0 | .30 | 700 | N | N | N | 50 | 700 | 2.0 | N | N |
| 233 | GA3136S | 46 42 29 | 112 59 46 | 3.0 | 1.5 | 3.0 | .50 | 1,500 | N | N | N | 70 | 1,500 | 3.0 | N | N |
| 234 | GA5638S | 46 40 57 | 112 58 56 | 3.0 | .7 | 2.0 | .50 | 500 | N | N | N | 70 | 1,000 | 3.0 | N | N |
| 235 | GA5644S | 46 42 17 | 112 55 6 | 3.0 | 1.0 | 1.5 | .50 | 1,000 | N | N | N | 30 | 1,000 | 1.5 | N | N |
| 236 | GA5646S | 46 42 34 | 112 54 55 | 2.0 | .7 | 1.0 | .30 | 700 | N | N | N | 100 | 1,000 | 3.0 | N | N |
| 237 | GA5648S | 46 42 34 | 112 55 19 | 3.0 | 1.5 | 3.0 | .50 | 500 | N | N | N | N | 1,500 | 1.5 | N | N |
| 238 | GA5650S | 46 42 56 | 112 55 14 | 5.0 | 1.0 | 3.0 | .50 | 700 | N | N | N | N | 1,500 | 1.5 | N | N |
| 239 | GA5652S | 46 43 56 | 112 55 55 | 3.0 | .7 | 1.0 | .50 | 1,000 | N | N | N | 70 | 1,500 | 2.0 | N | N |
| 240 | GA5654S | 46 43 52 | 112 55 52 | 3.0 | .7 | 1.5 | .50 | 1,500 | N | N | N | 50 | 1,500 | 3.0 | N | N |
| 241 | GA5656S | 46 44 39 | 112 56 9 | 2.0 | 1.0 | 1.5 | .30 | 1,000 | N | N | N | 10 | 1,500 | 3.0 | N | N |
| 242 | GA5675S | 46 40 24 | 112 47 40 | 3.0 | .7 | 1.5 | .20 | 1,500 | N | N | N | 20 | 1,000 | 7.0 | N | N |
| 243 | GA5677S | 46 41 8 | 112 47 39 | 2.0 | .5 | 1.5 | .30 | 1,000 | N | N | N | 10 | 1,500 | 2.0 | N | N |
| 244 | GA5678S | 46 40 21 | 112 47 35 | 5.0 | .7 | 1.5 | .50 | 5,000 | N | N | N | 20 | 1,500 | 7.0 | N | N |
| 245 | GA5680S | 46 41 8 | 112 47 55 | 3.0 | .7 | 1.5 | .50 | 2,000 | N | N | N | 10 | 1,500 | 5.0 | N | N |
| 246 | GA5682S | 46 41 8 | 112 47 55 | 3.0 | .7 | 1.0 | .30 | 1,500 | N | N | N | 10 | 1,500 | 3.0 | N | N |
| 247 | GA5684S | 46 40 19 | 112 47 22 | 5.0 | .7 | 1.5 | .30 | 1,500 | N | N | N | <10 | 1,500 | 2.0 | N | N |
| 248 | GA5732S | 46 41 13 | 112 53 54 | 3.0 | 1.0 | .7 | .50 | 700 | N | N | N | 70 | 500 | 1.5 | N | N |
| 249 | GA5742S | 46 43 20 | 112 53 17 | 3.0 | 1.5 | 1.5 | .50 | 1,000 | N | N | N | 70 | 2,000 | 3.0 | N | N |
| 250 | GA5744S | 46 43 15 | 112 53 17 | 5.0 | 1.5 | 2.0 | .50 | 1,500 | N | N | N | 20 | 1,500 | 2.0 | N | N |
| 251 | GA5746S | 46 43 15 | 112 53 17 | 3.0 | 1.0 | 2.0 | .50 | 1,000 | N | N | N | 20 | 1,500 | 2.0 | N | N |
| 252 | GA5748S | 46 44 29 | 112 50 46 | 3.0 | 1.0 | 1.5 | .70 | 500 | N | N | N | 15 | 2,000 | 2.0 | N | N |
| 253 | GA5750S | 46 41 44 | 112 51 42 | 5.0 | 2.0 | 2.0 | .70 | 700 | N | N | N | 20 | 2,000 | 1.5 | N | N |
| 254 | GA8857S | 46 43 35 | 112 47 49 | 5.0 | 1.0 | 1.5 | .50 | 700 | N | N | N | 70 | 1,500 | 3.0 | N | N |
| 255 | GA8859S | 46 43 28 | 112 47 57 | 3.0 | 1.0 | 1.5 | .30 | 700 | N | N | N | N | 1,500 | 2.0 | N | N |
| 256 | GA8861S | 46 43 27 | 112 47 43 | 2.0 | .7 | 1.5 | .30 | 700 | N | N | N | 10 | 1,500 | 5.0 | N | N |
| 257 | GA8919S | 46 44 16 | 112 59 29 | 5.0 | 1.5 | 1.5 | .50 | 1,500 | N | N | N | 150 | 1,000 | 2.0 | N | N |
| 258 | GA8921S | 46 44 16 | 112 59 3 | 3.0 | .5 | 1.5 | .50 | 700 | N | N | N | 10 | 2,000 | 1.5 | N | N |
| 259 | GA8923S | 46 44 8 | 112 58 59 | 3.0 | .7 | 2.0 | .50 | 3,000 | N | N | N | 10 | 1,500 | 3.0 | N | N |
| 260 | HLM5658S | 46 45 35 | 112 53 28 | 2.0 | 1.0 | 3.0 | .30 | 700 | N | N | N | 50 | 1,000 | 5.0 | N | N |
| 261 | HLM5660S | 46 46 30 | 112 56 40 | 3.0 | 1.5 | 1.5 | .50 | 700 | N | N | N | 200 | 700 | 2.0 | N | N |
| 262 | HLM5662S | 46 46 23 | 112 54 36 | 2.0 | .7 | .3 | .50 | 300 | N | N | N | 150 | 1,000 | 3.0 | N | N |
| 263 | HLM5663S | 46 46 39 | 112 55 45 | 3.0 | .7 | .7 | .50 | 2,000 | N | N | N | 50 | 700 | 1.5 | N | N |
| 264 | HLM5665S | 46 47 36 | 112 56 42 | 3.0 | .7 | .5 | .30 | 1,500 | N | N | N | 100 | 1,500 | 3.0 | N | N |
| 265 | HLM5667S | 46 48 17 | 112 56 27 | 3.0 | 7.0 | .7 | .30 | 1,000 | N | N | N | 100 | 1,500 | 3.0 | N | N |
| 266 | HLM5669S | 46 49 27 | 112 55 46 | 5.0 | 1.5 | 3.0 | .50 | 700 | N | N | N | 30 | 2,000 | 1.5 | N | N |
| 267 | HLM6614S | 46 50 38 | 112 53 50 | 7.0 | 3.0 | 3.0 | .70 | 1,000 | N | N | N | 30 | 700 | 1.5 | N | N |
| 268 | HLM6616S | 46 49 29 | 112 53 0 | 1.5 | .5 | .7 | .20 | 500 | N | N | N | 50 | 1,000 | 1.5 | N | N |
| 269 | HLM6618S | 46 49 32 | 112 53 36 | 5.0 | 1.0 | .7 | .50 | 1,000 | N | N | N | 70 | 1,000 | 2.0 | N | N |
| 270 | HLM6620S | 46 49 34 | 112 54 2 | 2.0 | .5 | 1.5 | .30 | 300 | N | N | N | 50 | 1,500 | 2.0 | N | N |
| 271 | HLM6621S | 46 52 20 | 112 59 28 | .3 | .2 | 3.0 | .05 | 150 | N | N | N | 50 | 300 | 1.5 | N | N |
| 272 | HLM6623S | 46 50 50 | 112 58 28 | 1.5 | .5 | 1.5 | .50 | 500 | N | N | N | 70 | 700 | 1.5 | N | N |
| 273 | HLM6625S | 46 50 20 | 112 57 3 | 1.5 | 1.5 | 2.0 | .30 | 700 | N | N | N | 50 | 1,000 | 1.5 | N | N |
| 274 | HLM6626S | 46 49 3 | 112 59 9 | 3.0 | 1.5 | 7.0 | .70 | 1,000 | N | N | N | 30 | 1,500 | 1.5 | N | N |
| 275 | HLM6627S | 46 49 1 | 112 59 21 | 3.0 | 1.5 | 10.0 | .30 | 1,000 | N | N | N | 50 | 1,000 | 2.0 | N | N |
| 276 | HLM6629S | 46 47 20 | 112 59 19 | 3.0 | 1.5 | 1.0 | .50 | 1,000 | N | N | N | 150 | 1,500 | 3.0 | N | N |

# CHAPTER D

## LATITUDE 46°30'-47°00' LONGITUDE 112°30'-113°00'

## TABLE 3. STREAM-SEDIMENT SAMPLE LOCALITY AND ANALYSES IN THE BUTTE 1°X2° CUSMAP QUADRANGLE, MONTANA (continued)

| | SAMPLE | S-CO | S-CR | S-CU | S-LA | S-MO | S-NB | S-NI | S-PB | S-SB | S-SC | S-SN | S-SR | S-V | S-W | S-Y | S-ZN | S-ZR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 228 | BUN3127S | 7 | 30 | 150 | 30 | <5 | <20 | 10 | 50 | N | 7 | N | 300 | 70 | N | 30 | N | 150 |
| 229 | GA3127S | 10 | 70 | 30 | 30 | N | <20 | 30 | 30 | N | 10 | N | 200 | 150 | N | 20 | N | 150 |
| 230 | GA3130S | 10 | 70 | 30 | 30 | N | <20 | 30 | 20 | N | 10 | N | 150 | 150 | N | 20 | N | 300 |
| 231 | GA3132S | 7 | 50 | 30 | 30 | N | N | 15 | 30 | N | 5 | N | 200 | 70 | N | 20 | N | 200 |
| 232 | GA3134S | 7 | 70 | 30 | 50 | N | N | 50 | 30 | N | 7 | N | 500 | 70 | N | 20 | N | 150 |
| 233 | GA3136S | 15 | 100 | 30 | 50 | N | <20 | 70 | 30 | N | 10 | N | 500 | 100 | N | 30 | N | 200 |
| 234 | GA5638S | 10 | 70 | 30 | 50 | N | <20 | 30 | 20 | N | 7 | N | 300 | 70 | N | 20 | N | 150 |
| 235 | GA5644S | 10 | 100 | 30 | 50 | N | <20 | 50 | 30 | N | 7 | N | 700 | 70 | N | 15 | N | 150 |
| 236 | GA5646S | 7 | 70 | 20 | 30 | N | <20 | 30 | 20 | N | 5 | N | 300 | 7 | N | 20 | N | 200 |
| 237 | GA5648S | 10 | 150 | 30 | 50 | N | <20 | 70 | 30 | N | 7 | N | 1,000 | 100 | N | 15 | N | 100 |
| 238 | GA5650S | 10 | 70 | 30 | 70 | N | N | 50 | 30 | N | 7 | N | 1,500 | 100 | N | 15 | 200 | 150 |
| 239 | GA5652S | 10 | 100 | 30 | 70 | N | <20 | 30 | 50 | N | 10 | N | 500 | 100 | N | 20 | N | 200 |
| 240 | GA5654S | 10 | 100 | 30 | 70 | N | <20 | 70 | 30 | N | 10 | N | 500 | 100 | N | 20 | N | 200 |
| 241 | GA5656S | 7 | 70 | 30 | 50 | N | N | 50 | 30 | N | 5 | N | 500 | 50 | N | 15 | N | 100 |
| 242 | GA5675S | 10 | 30 | 30 | 50 | N | N | 20 | 20 | N | 7 | N | 300 | 50 | N | 50 | N | 150 |
| 243 | GA5677S | 7 | 30 | 20 | 50 | N | N | 15 | 30 | N | 5 | N | 700 | 30 | N | 30 | N | 200 |
| 244 | GA5678S | 10 | 30 | 30 | 70 | N | N | 50 | 30 | N | 7 | N | 500 | 70 | N | 30 | N | 200 |
| 245 | GA5680S | 10 | 50 | 20 | 70 | N | <20 | 20 | 30 | N | 7 | N | 700 | 50 | N | 30 | N | 300 |
| 246 | GA5682S | 7 | 50 | 20 | 70 | N | N | 15 | 30 | N | 5 | N | 700 | 50 | N | 20 | N | 150 |
| 247 | GA5684S | 10 | 30 | 20 | 50 | N | N | 20 | 30 | N | 5 | N | 700 | 70 | N | 20 | N | 150 |
| 248 | GA5732S | 7 | 70 | 30 | 20 | N | N | 30 | 20 | N | 7 | N | 100 | 150 | N | 20 | N | 150 |
| 249 | GA5742S | 10 | 100 | 20 | 50 | N | N | 30 | 30 | N | 7 | N | 500 | 70 | N | 30 | N | 300 |
| 250 | GA5744S | 10 | 150 | 30 | 70 | N | N | 70 | 30 | N | 7 | N | 700 | 70 | N | 20 | N | 300 |
| 251 | GA5746S | 10 | 150 | 30 | 70 | N | <20 | 70 | 30 | N | 7 | N | 700 | 70 | N | 20 | N | 300 |
| 252 | GA5748S | 10 | 150 | 20 | 70 | N | <20 | 50 | 50 | N | 7 | N | 1,000 | 100 | N | 15 | N | 300 |
| 253 | GA5750S | 15 | 150 | 50 | 70 | N | <20 | 70 | 30 | N | 10 | N | 1,000 | 100 | N | 20 | N | 200 |
| 254 | GA8857S | 10 | 100 | 30 | 70 | N | N | 70 | 30 | N | 10 | N | 700 | 100 | N | 30 | N | 150 |
| 255 | GA8859S | 10 | 70 | 15 | 50 | N | N | 30 | 20 | N | 7 | N | 700 | 70 | N | 15 | N | 150 |
| 256 | GA8861S | 7 | 20 | 20 | 50 | N | N | 15 | 20 | N | 5 | N | 1,000 | 70 | N | 20 | N | 100 |
| 257 | GA8919S | 10 | 50 | 30 | 50 | N | N | 30 | 100 | N | 10 | N | 200 | 100 | N | 30 | N | 300 |
| 258 | GA8921S | 7 | 100 | 30 | 70 | N | <20 | 30 | 30 | N | 10 | N | 700 | 70 | N | 20 | N | 200 |
| 259 | GA8923S | 15 | 100 | 30 | 70 | N | <20 | 70 | 30 | N | 10 | N | 500 | 100 | N | 30 | N | 200 |
| 260 | HLM5658S | 7 | 50 | 30 | 50 | N | <20 | 30 | 30 | N | 7 | N | 300 | 70 | N | 20 | N | 150 |
| 261 | HLM5660S | 10 | 70 | 20 | 70 | N | <20 | 50 | 30 | N | 7 | N | 200 | 100 | N | 30 | N | 200 |
| 262 | HLM5662S | 7 | 100 | 20 | 50 | N | <20 | 30 | 20 | N | 5 | N | 100 | 50 | N | 50 | N | 500 |
| 263 | HLM5663S | 10 | 50 | 20 | 30 | N | <20 | 30 | 30 | N | 5 | N | 150 | 70 | N | 15 | N | 200 |
| 264 | HLM5665S | 7 | 50 | 30 | 30 | N | <20 | 20 | 20 | N | 7 | N | 100 | 70 | N | 30 | N | 200 |
| 265 | HLM5667S | 10 | 70 | 30 | 50 | N | <20 | 30 | 30 | N | 7 | N | 200 | 70 | N | 30 | N | 200 |
| 266 | HLM5669S | 15 | 100 | 30 | 70 | N | <20 | 70 | 30 | N | 7 | N | 700 | 100 | N | 20 | N | 150 |
| 267 | HLM6614S | 10 | 150 | 70 | 50 | N | <20 | 50 | 30 | N | 10 | N | 500 | 200 | N | 30 | N | 150 |
| 268 | HLM6616S | <5 | 20 | 7 | 30 | N | <20 | 10 | 30 | N | 5 | N | 500 | 30 | N | 20 | N | 200 |
| 269 | HLM6618S | 10 | 70 | 50 | 50 | N | <20 | 30 | 30 | N | 10 | N | 200 | 70 | N | 30 | N | 300 |
| 270 | HLM6620S | 7 | 50 | 15 | 30 | N | <20 | 15 | 30 | N | 5 | N | 700 | 50 | N | 30 | N | 300 |
| 271 | HLM6621S | N | 10 | 20 | 20 | N | N | 5 | 30 | N | <5 | N | 300 | 30 | N | <10 | N | 30 |
| 272 | HLM6623S | 7 | 20 | 10 | 50 | N | N | 7 | 30 | N | 5 | N | 500 | 50 | N | 20 | N | 200 |
| 273 | HLM6625S | 5 | 20 | 20 | 20 | N | N | 7 | 30 | N | <5 | N | 300 | 50 | N | 20 | N | 200 |
| 274 | HLM6626S | 15 | 70 | 20 | 50 | N | <20 | 30 | 30 | N | 10 | N | 1,000 | 100 | N | 30 | N | 300 |
| 275 | HLM6627S | 10 | 50 | 30 | 50 | N | <20 | 20 | 50 | N | 10 | N | 1,000 | 70 | N | 20 | N | 150 |
| | | | [illegible] | 70 | 70 | N | <20 | 50 | 30 | N | 10 | N | 300 | 100 | N | 30 | N | 300 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 228 | BUN3127S | N | -- | -- | -- | -- | -- | -- | -- |
| 229 | GA3127S | N | 17 | 13 | 27 | .13 | .65 | 1 | N |
| 230 | GA3131S | N | 6 | 7 | 16 | <.05 | .40 | <1 | N |
| 231 | GA3132S | N | 18 | 18 | 46 | .11 | .55 | 1 | N |
| 232 | GA3134S | N | 18 | 15 | 35 | .12 | .60 | 1 | N |
| 233 | GA3136S | N | 12 | 13 | 37 | .07 | .55 | 1 | N |
| 234 | GA5638S | N | 12 | 15 | 53 | .06 | .40 | <1 | N |
| 235 | GA5644S | N | 7 | 13 | 35 | .05 | 1.70 | <1 | N |
| 236 | GA5646S | N | 8 | 11 | 19 | .10 | .50 | <1 | N |
| 237 | GA5648S | N | 10 | 9 | 26 | .13 | .30 | <1 | N |
| 238 | GA5650S | N | 6 | 7 | 15 | .07 | .30 | <1 | N |
| 239 | GA5652S | N | 12 | 19 | 22 | .07 | .50 | <1 | 1 |
| 240 | GA5654S | N | 12 | 12 | 23 | .11 | .40 | <1 | 1 |
| 241 | GA5656S | N | 11 | 13 | 15 | .18 | .30 | <1 | N |
| 242 | GA5675S | N | 21 | 23 | 35 | .51 | 1.05 | <1 | 2 |
| 243 | GA5677S | N | 7 | 10 | 12 | .11 | .70 | <1 | N |
| 244 | GA5678S | N | 15 | 16 | 31 | .30 | .75 | <1 | 1 |
| 245 | GA5680S | N | 7 | 12 | 12 | .16 | .30 | <1 | N |
| 246 | GA5682S | N | 7 | 12 | 12 | .15 | .35 | <1 | N |
| 247 | GA5684S | N | 8 | 12 | 15 | .11 | .35 | <1 | N |
| 248 | GA5732S | N | 6 | 8 | 18 | .06 | .30 | <1 | N |
| 249 | GA5742S | N | 9 | 12 | 20 | <.05 | .40 | <1 | 1 |
| 250 | GA5744S | N | 14 | 13 | 34 | <.05 | .55 | <1 | 1 |
| 251 | GA5746S | N | 14 | 14 | 37 | <.05 | .55 | <1 | 1 |
| 252 | GA5748S | N | 3 | 7 | 2 | <.05 | .05 | <1 | N |
| 253 | GA5750S | N | 11 | 13 | 30 | .25 | .35 | <1 | 1 |
| 254 | GA8857S | N | 10 | 24 | 14 | .23 | .30 | <1 | 1 |
| 255 | GA8859S | N | 8 | 21 | 13 | .15 | .40 | <1 | 1 |
| 256 | GA8861S | N | 12 | 25 | 9 | .25 | .50 | <1 | 1 |
| 257 | GA8919S | N | 17 | 62 | 4 | <.05 | .60 | <1 | 22 |
| 258 | GA8921S | N | 13 | 8 | <1 | <.05 | .25 | <1 | N |
| 259 | GA8923S | N | 12 | 7 | <1 | .05 | .30 | <1 | N |
| 260 | HLM5658S | N | 19 | 23 | 43 | .20 | .75 | 1 | 1 |
| 261 | HLM5660S | N | 8 | 11 | 11 | <.05 | .20 | <1 | 1 |
| 262 | HLM5662S | N | 5 | 5 | 5 | <.05 | .15 | <1 | 1 |
| 263 | HLM5663S | N | 4 | 13 | 20 | <.05 | .25 | <1 | 1 |
| 264 | HLM5665S | N | 13 | 9 | 20 | .09 | .25 | <1 | 1 |
| 265 | HLM5667S | N | 13 | 10 | 15 | .05 | .30 | <1 | 1 |
| 266 | HLM5669S | N | 15 | 13 | 14 | .18 | .35 | <1 | N |
| 267 | HLM6614S | N | 26 | 18 | 16 | .70 | .45 | 1 | N |
| 268 | HLM6616S | N | 4 | 5 | 25 | 1.89 | .10 | <1 | N |
| 269 | HLM6618S | N | 12 | 12 | 12 | 1.42 | .15 | <1 | 1 |
| 270 | HLM6620S | N | 28 | 28 | 20 | 6.68 | .55 | <1 | N |
| 271 | HLM6621S | N | 7 | 6 | 3 | 1.44 | .20 | 1 | N |
| 272 | HLM6623S | N | 5 | 4 | 5 | 2.02 | .15 | <1 | N |
| 273 | HLM6625S | N | 14 | 9 | 8 | 1.01 | .35 | 1 | 1 |
| 274 | HLM6626S | N | 13 | 7 | 17 | 1.62 | .25 | 1 | 1 |
| 275 | HLM6627S | N | 12 | 10 | 9 | 1.21 | .40 | 1 | 1 |
| 276 | HLM6629S | N | 18 | 8 | 14 | .60 | .15 | 1 | N |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 277 | HLM6631S | 46 47 20 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 70 | 1,500 | 2.0 | [illegible] | [illegible] |
| 278 | HLM8925S | 46 45 33 | 112 59 49 | 3.0 | 1.0 | 1.5 | .50 | 1,000 | N | N | N | 15 | 2,000 | 1.5 | N | N |
| 279 | NLK5740S | 46 46 33 | 112 49 13 | 3.0 | 1.5 | 2.0 | .70 | 500 | N | N | N | <10 | 2,000 | 1.5 | N | N |
| 280 | NLK8902S | 46 46 52 | 112 47 47 | 5.0 | 1.5 | 3.0 | 1.00 | 1,000 | N | N | N | 20 | 1,500 | 2.0 | N | N |
| 281 | NLK8904S | 46 46 40 | 112 47 53 | 3.0 | 1.0 | 1.5 | .70 | 1,000 | N | N | N | | | | N | N |
| 282 | NLK8906S | 46 46 43 | 112 47 59 | 5.0 | 2.0 | 2.0 | .70 | 1,500 | N | N | N | N | 2,000 | 2.0 | N | N |
| 283 | NLK8908S | 46 45 14 | 112 47 22 | 5.0 | 3.0 | 2.0 | .70 | 1,500 | N | N | N | <10 | 3,000 | 2.0 | N | N |
| 284 | NLK8910S | 46 48 23 | 112 50 30 | 3.0 | 1.0 | 1.0 | .30 | 1,500 | N | N | N | 100 | 1,500 | 5.0 | N | N |
| 285 | NLK8912S | 46 48 22 | 112 50 20 | 3.0 | 1.0 | 1.0 | .50 | 1,000 | N | N | N | 30 | 1,500 | 2.0 | N | N |
| 286 | NLK8913S | 46 48 51 | 112 51 19 | 2.0 | .7 | .5 | .30 | 1,000 | N | N | N | 100 | 1,000 | 3.0 | N | N |
| 287 | NLK8915S | 46 46 32 | 112 46 3 | 3.0 | .7 | 1.5 | .30 | 1,500 | N | N | N | 30 | 1,500 | 3.0 | N | N |
| 288 | NLK8917S | 46 46 12 | 112 45 26 | 3.0 | 1.0 | 1.5 | .50 | 3,000 | N | N | N | 20 | 1,500 | 2.0 | N | N |
| 289 | BRO8846S | 46 53 29 | 113 5 54 | 3.0 | .7 | 1.50 | .50 | 1,000 | N | N | N | 50 | 1,500 | 2.0 | N | |
| 290 | BRO8848S | 46 54 5 | 113 6 39 | 3.0 | 1.5 | .70 | .50 | 700 | N | N | N | 30 | 1,000 | <1.0 | N | |
| 291 | BRO8850S | 46 53 26 | 113 6 52 | 1.5 | 1.0 | 1.00 | .20 | 500 | N | N | N | 50 | 700 | 1.5 | N | |
| 292 | BRO8852S | 46 52 51 | 113 7 15 | 5.0 | 2.0 | 2.00 | .70 | 1,000 | N | N | N | 10 | 2,000 | 1.0 | N | |
| 293 | BRO8854S | 46 53 13 | 113 2 46 | 3.0 | 1.5 | 1.50 | .30 | 500 | N | N | N | 100 | 1,000 | 2.0 | N | |
| 294 | BRO8855S | 46 52 40 | 113 2 43 | 5.0 | 2.0 | 1.50 | .50 | 1,000 | N | N | N | 70 | 1,500 | 1.5 | N | |
| 295 | CHL7949S | 46 48 26 | 113 3 38 | 5.0 | 1.5 | 3.00 | .50 | 1,500 | N | N | N | 20 | 1,500 | 2.0 | N | |
| 296 | CHL7951S | 46 48 48 | 113 5 49 | 7.0 | 2.0 | 2.00 | .70 | >5,000 | N | N | N | 30 | 2,000 | 1.5 | N | |
| 297 | CHL7979S | 46 52 27 | 113 1 43 | 3.0 | 2.0 | 2.00 | .50 | 1,000 | N | N | N | 70 | 1,000 | 2.0 | N | |
| 298 | CHL7980S | 46 51 48 | 113 0 58 | 5.0 | 2.0 | 3.00 | .50 | 2,000 | N | N | N | 150 | 700 | 2.0 | N | |
| 299 | CHL7982S | 46 49 42 | 113 4 47 | 5.0 | 2.0 | 2.00 | .70 | 1,500 | N | N | N | N | 3,000 | 1.0 | N | |
| 300 | CHL7983S | 46 49 38 | 113 5 4 | 5.0 | 1.5 | 2.00 | .70 | 2,000 | N | N | N | 10 | 2,000 | 1.5 | N | |
| 301 | CHL7984S | 46 50 45 | 113 5 0 | 5.0 | 3.0 | 3.00 | .70 | 2,000 | N | N | N | 15 | 2,000 | 1.0 | N | |
| 302 | CHL7987S | 46 51 3 | 113 6 52 | 5.0 | 2.0 | 3.00 | .50 | 1,000 | N | N | N | <10 | 2,000 | 1.5 | N | |
| 303 | CHL7989S | 46 51 27 | 113 4 33 | 5.0 | 3.0 | 3.00 | .70 | 1,500 | N | N | N | 10 | 2,000 | 1.5 | N | |
| 304 | CHL7990S | 46 51 47 | 113 4 17 | 3.0 | 1.5 | 1.00 | .50 | 2,000 | N | N | N | 50 | 1,500 | 2.0 | N | |
| 305 | CHL7992S | 46 52 3 | 113 3 52 | 5.0 | 2.0 | 1.00 | .70 | 1,500 | N | N | N | 70 | 2,000 | 2.0 | N | |
| 306 | CHL7993S | 46 50 37 | 113 0 57 | 1.5 | 1.5 | 10.00 | .15 | 500 | N | N | N | 50 | 150 | 2.0 | N | |
| 307 | CHL7994S | 46 49 35 | 113 0 41 | 5.0 | 2.0 | 3.00 | .70 | 1,500 | N | N | N | 50 | 2,000 | 2.0 | N | |
| 308 | CHL7996S | 46 49 35 | 113 1 31 | 7.0 | 2.0 | 3.00 | 1.00 | 2,000 | N | N | N | 20 | 2,000 | 1.0 | N | |
| 309 | CHL8808S | 46 49 23 | 113 2 13 | 5.0 | 1.5 | 3.00 | .50 | 1,000 | N | N | N | N | 2,000 | 1.0 | N | |
| 310 | CHL8809S | 46 49 4 | 113 2 27 | 7.0 | 2.0 | 3.00 | .50 | 1,000 | N | N | N | 10 | 1,500 | 1.5 | N | |
| 311 | CHL8811S | 46 49 0 | 113 3 0 | 7.0 | 1.5 | 3.00 | .50 | 1,000 | N | N | N | 10 | 2,000 | 1.0 | N | |
| 312 | CHL8813S | 46 48 18 | 113 2 28 | 5.0 | 1.0 | 1.50 | .30 | 1,500 | N | N | N | N | 2,000 | 1.5 | N | |
| 313 | CHL8815S | 46 47 35 | 113 5 50 | 3.0 | .7 | 1.00 | .30 | 500 | N | N | N | 30 | 700 | 5.0 | N | |
| 314 | CHL8816S | 46 46 51 | 113 4 51 | 3.0 | .7 | 1.50 | .50 | 700 | N | N | N | 10 | 1,500 | 2.0 | N | |
| 315 | CHL8817S | 46 47 17 | 113 4 53 | 3.0 | 1.0 | 2.00 | .50 | 1,500 | N | N | N | 20 | 1,000 | 3.0 | N | |
| 316 | CHL8818S | 46 45 22 | 113 1 20 | 2.0 | .7 | .30 | .30 | 300 | N | N | N | 100 | 700 | 2.0 | N | |
| 317 | CHL8819S | 46 45 46 | 113 1 12 | 3.0 | 1.0 | 1.50 | .50 | 1,000 | N | N | N | 10 | 2,000 | 1.0 | N | |
| 318 | CHL8821S | 46 46 15 | 113 1 55 | 5.0 | 1.5 | 2.00 | .70 | 500 | N | N | N | <10 | 5,000 | 1.0 | N | |
| 319 | CHL8823S | 46 46 26 | 113 2 10 | 5.0 | 1.0 | 1.50 | .50 | 1,000 | N | N | N | 10 | 1,500 | 1.5 | N | |
| 320 | CHL8825S | 46 46 51 | 113 4 6 | 3.0 | .7 | 1.50 | .50 | 1,000 | N | N | N | 10 | 1,500 | 1.5 | N | |
| 321 | CHL8827S | 46 46 0 | 113 4 55 | 3.0 | 1.0 | 2.00 | .50 | 1,000 | N | N | N | 30 | 1,500 | 3.0 | N | |
| 322 | CHL8826S | 46 46 2 | 113 5 0 | 3.0 | 1.0 | 3.00 | .50 | 1,000 | N | N | N | 30 | 500 | 1.5 | N | |
| 323 | DRU2419S | 46 41 7 | 113 12 17 | 1.5 | .3 | .50 | .30 | 200 | N | N | N | 50 | 300 | 1.0 | N | |
| 324 | DRU2420S | 46 41 13 | 113 12 37 | 2.0 | 1.0 | 2.00 | .30 | 300 | N | N | N | 70 | 500 | 1.0 | N | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 277 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | N | [illegible] | [illegible] | [illegible] | N | [illegible] | N | [illegible] | [illegible] | N | [illegible] | N | [illegible] |
| 278 | HLM8925S | 15 | 100 | 30 | 70 | N | <20 | 70 | 30 | N | 10 | N | 300 | 100 | N | 20 | N | 300 |
| 279 | NLK5740S | 10 | 150 | 20 | 70 | N | <20 | 70 | 30 | N | 7 | N | 1,000 | 100 | N | 15 | N | 300 |
| 280 | NLK8902S | 10 | 150 | 30 | 30 | N | <20 | 50 | 30 | N | 7 | N | 1,500 | 150 | N | 10 | N | 700 |
| 281 | NLK8904S | 10 | 70 | 30 | 70 | N | <20 | 50 | 50 | N | 7 | N | 700 | 100 | N | 20 | N | 300 |
| 282 | NLK8906S | 15 | 150 | 30 | 100 | N | N | 70 | 50 | N | 10 | N | 1,000 | 150 | N | 20 | N | 300 |
| 283 | NLK8908S | 15 | 200 | 30 | 70 | N | <20 | 100 | 30 | N | 10 | N | 1,500 | 150 | N | 15 | N | 200 |
| 284 | NLK8910S | 10 | 70 | 50 | 50 | N | <20 | 30 | 50 | N | 10 | N | 300 | 100 | N | 30 | N | 300 |
| 285 | NLK8912S | 10 | 100 | 30 | 70 | N | <20 | 70 | 30 | N | 10 | N | 700 | 100 | N | 20 | N | 300 |
| 286 | NLK8913S | 7 | 70 | 20 | 30 | N | <20 | 20 | 30 | N | 7 | N | 200 | 70 | N | 30 | N | 200 |
| 287 | NLK8915S | 10 | 70 | 30 | 70 | N | <20 | 30 | 30 | N | 7 | N | 700 | 100 | N | 30 | N | 300 |
| 288 | NLK8917S | 10 | 100 | 30 | 70 | N | <20 | 50 | 30 | N | 10 | N | 700 | 100 | N | 20 | N | 200 |
| 289 | BRO8846S | N | 10 | 70 | 30 | 70 | N | N | 50 | 30 | N | 7 | N | 700 | 70 | N | 20 | N |
| 290 | BRO8848S | N | 10 | 100 | 30 | 70 | N | N | 30 | 30 | N | 7 | N | 300 | 70 | N | 30 | N |
| 291 | BRO8850S | N | 7 | 70 | 30 | 20 | N | N | 20 | 30 | N | 5 | N | 300 | 50 | N | 20 | N |
| 292 | BRO8852S | N | 15 | 200 | 30 | 50 | N | N | 100 | 30 | N | 10 | N | 1,000 | 70 | N | 20 | N |
| 293 | BRO8854S | N | 10 | 70 | 30 | 30 | N | <20 | 30 | 30 | N | 7 | N | 300 | 70 | N | 20 | N |
| 294 | BRO8855S | N | 10 | 150 | 20 | 50 | N | <20 | 70 | 20 | N | 10 | N | 700 | 70 | N | 20 | N |
| 295 | CHL7949S | N | 10 | 100 | 30 | 70 | N | <20 | 70 | 30 | N | 10 | N | 500 | 100 | N | 30 | N |
| 296 | CHL7951S | N | 20 | 150 | 50 | 100 | N | <20 | 100 | 30 | N | 10 | N | 700 | 100 | N | 20 | N |
| 297 | CHL7979S | N | 7 | 70 | 30 | 50 | N | N | 30 | 30 | N | 10 | N | 300 | 70 | N | 20 | N |
| 298 | CHL7980S | N | 10 | 70 | 50 | 50 | N | N | 50 | 50 | N | 10 | N | 300 | 100 | N | 30 | N |
| 299 | CHL7982S | N | 15 | 200 | 30 | 70 | N | <20 | 100 | 30 | N | 10 | N | 2,000 | 150 | N | 20 | N |
| 300 | CHL7983S | N | 15 | 150 | 50 | 70 | N | <20 | 100 | 30 | N | 7 | N | 1,500 | 150 | N | 15 | N |
| 301 | CHL7984S | N | 15 | 500 | 30 | 100 | N | <20 | 100 | 30 | N | 15 | N | 1,500 | 150 | N | 20 | N |
| 302 | CHL7987S | N | 15 | 150 | 30 | 70 | N | <20 | 100 | 30 | N | 10 | N | 1,500 | 100 | N | 15 | N |
| 303 | CHL7989S | N | 15 | 200 | 30 | 70 | N | <20 | 100 | 30 | N | 15 | N | 2,000 | 150 | N | 20 | N |
| 304 | CHL7990S | N | 10 | 100 | 30 | 70 | N | <20 | 70 | 30 | N | 7 | N | 500 | 100 | N | 20 | N |
| 305 | CHL7992S | N | 15 | 150 | 30 | 70 | N | <20 | 100 | 30 | N | 10 | N | 300 | 150 | N | 30 | N |
| 306 | CHL7993S | N | <5 | 20 | 20 | 30 | N | N | 5 | 10 | N | 5 | N | 1,000 | 30 | N | 10 | N |
| 307 | CHL7994S | N | 15 | 150 | 30 | 150 | N | <20 | 100 | 30 | N | 15 | N | 700 | 150 | N | 20 | N |
| 308 | CHL7996S | N | 15 | 150 | 30 | 50 | N | N | 50 | 30 | N | 7 | N | 1,000 | 200 | N | 20 | N |
| 309 | CHL8808S | N | 15 | 150 | 30 | 70 | N | N | 70 | 30 | N | 10 | N | 1,000 | 100 | N | 15 | N |
| 310 | CHL8809S | N | 20 | 150 | 30 | 100 | N | <20 | 100 | 30 | N | 10 | N | 1,000 | 100 | N | 20 | N |
| 311 | CHL8811S | N | 15 | 150 | 30 | 100 | N | N | 70 | 30 | N | 10 | N | 1,000 | 100 | N | 15 | N |
| 312 | CHL8813S | N | 15 | 100 | 30 | 70 | N | <20 | 70 | 30 | N | 10 | N | 1,000 | 100 | N | 15 | N |
| 313 | CHL8815S | N | 10 | 30 | 30 | 30 | N | <20 | 20 | 30 | N | 10 | N | 300 | 70 | N | 30 | N |
| 314 | CHL8816S | N | 10 | 100 | 30 | 70 | N | <20 | 70 | 30 | N | 10 | N | 700 | 100 | N | 20 | N |
| 315 | CHL8817S | N | 15 | 100 | 30 | 70 | N | <20 | 70 | 30 | N | 10 | N | 500 | 100 | N | 30 | N |
| 316 | CHL8818S | N | 7 | 50 | 10 | 20 | N | N | 15 | 20 | N | 7 | N | 100 | 50 | N | 30 | N |
| 317 | CHL8819S | N | 15 | 150 | 30 | 70 | N | N | 70 | 20 | N | 10 | N | 1,000 | 70 | N | 20 | N |
| 318 | CHL8821S | N | 10 | 150 | 30 | 70 | N | <20 | 70 | 30 | N | 7 | N | 1,000 | 100 | N | 10 | N |
| 319 | CHL8823S | N | 10 | 70 | 30 | 70 | N | <20 | 70 | 20 | N | 7 | N | 1,000 | 70 | N | 15 | N |
| 320 | CHL8825S | N | 15 | 100 | 30 | 70 | N | <20 | 70 | 30 | N | 7 | N | 700 | 70 | N | 20 | N |
| 321 | CHL8827S | N | 10 | 50 | 30 | 50 | N | <20 | 30 | 15 | N | 10 | N | 500 | 70 | N | 30 | N |
| 322 | CHL8828S | N | 7 | 15 | 30 | 30 | N | <20 | 5 | 10 | N | 10 | N | 500 | 70 | N | 20 | N |
| 323 | DRU2419S | N | 7 | 15 | 15 | 20 | N | N | 7 | 30 | N | 5 | N | 150 | 30 | N | 15 | N |
| 324 | DRU2420S | N | 10 | 70 | 20 | 30 | N | <20 | 30 | 30 | N | 7 | N | 300 | 50 | N | 20 | N |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 277 | HLM6631S | N | 12 | 8 | 13 | .74 | .25 | 1 | 1 | |
| 278 | HLM8925S | N | 14 | 13 | 2 | <.05 | .25 | <1 | N | |
| 279 | NLK5740S | N | 9 | 9 | 41 | <.05 | .20 | <1 | N | |
| 280 | NLK8902S | N | 5 | 4 | 22 | .05 | .24 | <1 | <1 | |
| 281 | NLK8904S | N | 14 | 9 | 30 | .15 | .22 | 1 | 1 | |
| 282 | NLK8906S | N | 10 | 7 | 28 | .11 | .42 | <1 | 1 | |
| 283 | NLK8908S | N | 8 | 6 | 25 | .08 | .13 | <1 | 2 | |
| 284 | NLK8910S | N | 16 | 12 | 25 | .15 | .41 | <1 | 2 | |
| 285 | NLK8912S | N | 8 | 5 | 19 | .08 | .16 | 1 | 2 | |
| 286 | NLK8913S | N | 8 | 7 | 13 | .05 | .36 | <1 | <1 | |
| 287 | NLK8915S | N | 13 | 9 | 21 | .09 | .36 | <1 | 2 | |
| 288 | NLK8917S | N | 15 | 10 | 45 | .20 | .80 | <1 | 2 | |
| 289 | BR08846S | 200 | N | 10.0 | 16.0 | 33.0 | <.05 | .50 | 1.0 | 1 |
| 290 | BR08848S | 150 | N | 11.0 | 11.0 | 29.0 | <.05 | .15 | 1.0 | 1 |
| 291 | BR08850S | 200 | N | 7.0 | 3.0 | 5.0 | <.05 | .10 | 1.0 | <1 |
| 292 | BR08852S | 150 | N | 8.0 | 8.0 | 19.0 | <.05 | .20 | 1.0 | 1 |
| 293 | BR08854S | 150 | N | 12.0 | 14.0 | 68.0 | <.05 | .45 | 1.0 | 1 |
| 294 | BR08855S | 500 | N | 5.0 | 5.0 | 11.0 | <.05 | .15 | 1.0 | <1 |
| 295 | CHL7949S | 200 | N | 24.0 | 14.0 | 16.0 | .10 | <.05 | 4.0 | <1 |
| 296 | CHL7951S | 200 | N | 15.0 | 5.0 | 9.0 | .10 | <.05 | <1.0 | <1 |
| 297 | CHL7979S | 200 | N | 16.0 | 11.0 | 16.0 | .13 | .24 | <1.0 | <1 |
| 298 | CHL7980S | 300 | N | 18.0 | 17.0 | 43.0 | .15 | .56 | <1.0 | 1 |
| 299 | CHL7982S | 300 | N | 6.0 | 6.0 | 13.0 | .05 | .16 | <1.0 | <1 |
| 300 | CHL7983S | 300 | N | 8.0 | 6.0 | 22.0 | <.05 | .36 | <1.0 | 2 |
| 301 | CHL7984S | 300 | N | 8.0 | 4.0 | 22.0 | .08 | .35 | <1.0 | 2 |
| 302 | CHL7987S | 200 | N | 7.0 | 6.0 | 21.0 | .06 | .19 | <1.0 | <1 |
| 303 | CHL7989S | 200 | N | 8.0 | 7.0 | 29.0 | <.05 | .24 | <1.0 | 1 |
| 304 | CHL7990S | 300 | N | 9.0 | 9.0 | 20.0 | .07 | .32 | <1.0 | 1 |
| 305 | CHL7992S | 300 | N | 14.0 | 7.0 | 18.0 | .12 | .28 | <1.0 | 2 |
| 306 | CHL7993S | 70 | N | 8.0 | 2.0 | 22.0 | .11 | .25 | <1.0 | 2 |
| 307 | CHL7994S | 300 | N | 5.0 | 8.0 | 25.0 | .10 | .32 | <1.0 | 2 |
| 308 | CHL7996S | >1,000 | N | 14.0 | 5.0 | 24.0 | .05 | .28 | <1.0 | 2 |
| 309 | CHL8808S | 100 | N | 11.0 | 9.0 | 20.0 | <.05 | .15 | <1.0 | <1 |
| 310 | CHL8809S | 150 | N | 11.0 | 9.0 | 18.0 | <.05 | .15 | <1.0 | <1 |
| 311 | CHL8811S | 150 | N | 10.0 | 9.0 | 25.0 | <.05 | .15 | <1.0 | 1 |
| 312 | CHL8813S | 150 | N | 19.0 | 12.0 | 39.0 | <.05 | .20 | <1.0 | <1 |
| 313 | CHL8815S | 200 | N | 11.0 | 6.0 | 24.0 | <.05 | .10 | <1.0 | <1 |
| 314 | CHL8816S | 200 | N | 16.0 | 9.0 | 24.0 | <.05 | .25 | <1.0 | <1 |
| 315 | CHL8817S | 200 | N | 14.0 | 10.0 | 15.0 | <.05 | .30 | <1.0 | <1 |
| 316 | CHL8818S | 150 | N | 2.0 | 4.0 | 8.0 | <.05 | .10 | <1.0 | <1 |
| 317 | CHL8819S | 150 | N | 9.0 | 8.0 | 15.0 | <.05 | .15 | <1.0 | <1 |
| 318 | CHL8821S | 200 | N | 7.0 | 6.0 | 22.0 | <.05 | .15 | <1.0 | <1 |
| 319 | CHL8823S | 150 | N | 9.0 | 9.0 | 16.0 | .08 | .25 | <1.0 | <1 |
| 320 | CHL8825S | 200 | N | 11.0 | 11.0 | 14.0 | .06 | .25 | <1.0 | <1 |
| 321 | CHL8827S | 150 | N | 14.0 | 9.0 | 4.0 | <.05 | .20 | <1.0 | <1 |
| 322 | CHL8828S | 200 | N | 13.0 | 6.0 | 14.0 | .05 | .20 | <1.0 | <1 |
| 323 | DRU2419S | 200 | N | 7.0 | 12.0 | 13.0 | .07 | .15 | 1.0 | N |
| 324 | DRU2420S | 300 | N | 15.0 | 14.0 | 25.0 | .08 | .45 | 2.0 | 1 |

|  | SAMPLE | LATITUDE | LONGITUDE | S-FE% | S-MG% | S-CA% | S-TI% | S-MN | S-AG | S-AS | S-AU | S-B | S-BA | S-BE | S-BI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 325 | DRU3435S | 46 43 42 | 113 13 51 | 1.0 | 7.0 | 20.00 | .10 | 500 | N | N | N | 20 | 150 | [illegible] | N |
| 326 | DRU3437S | 46 43 47 | 113 13 42 | 2.0 | 5.0 | 10.00 | .20 | 700 | N | N | N | 100 | 300 | 1.5 | N |
| 327 | DRU3438S | 46 44 38 | 113 12 50 | 3.0 | 5.0 | 7.00 | .30 | 1,000 | N | N | N | 150 | 500 | 1.5 | H |
| 328 | DRU3440S | 46 41 50 | 113 11 24 | 3.0 | 2.0 | 10.00 | .20 | 1,000 | N | N | N | 100 | 300 | 1.5 | N |
| 329 | DRU3442S | 46 40 54 | 113 10 20 | 3.0 | 1.5 | 10.00 | .50 | 1,000 | N | N | N | 150 | 300 | 1.5 | N |
| 330 | DRU3443S | 46 41 21 | 113 9 9 | 3.0 | 1.5 | 2.00 | .50 | 1,000 | N | N | N | 100 | 500 | 1.5 | N |
| 331 | DRU3445S | 46 41 20 | 113 9 4 | 5.0 | 2.0 | 3.00 | .50 | 1,000 | N | N | N | 100 | 700 | 1.0 | N |
| 332 | DRU3448S | 46 42 56 | 113 12 25 | 1.5 | 2.0 | 20.00 | .20 | 700 | N | N | N | 30 | 300 | 1.5 | N |
| 333 | DRU3450S | 46 41 53 | 113 7 19 | 3.0 | .7 | 5.00 | .30 | 700 | N | N | N | 150 | 500 | 2.0 | N |
| 334 | DRU3451S | 46 40 55 | 113 8 0 | 5.0 | 1.0 | 2.00 | .50 | 1,000 | N | N | N | 100 | 700 | 1.5 | N |
| 335 | DRU7824S | 46 40 15 | 113 2 24 | 3.0 | [illegible] | .70 | .50 | 700 | N | N | N | 70 | 300 | 3.0 | N |
| 336 | DRU7826S | 46 42 59 | 113 2 41 | 5.0 | 1.0 | 1.50 | .70 | 1,000 | N | N | N | 20 | 1,000 | 3.0 | N |
| 337 | DRU7828S | 46 43 10 | 113 2 49 | 3.0 | 1.0 | 1.50 | .50 | 1,500 | N | N | N | 30 | 1,500 | 3.0 | N |
| 338 | DRU7830S | 46 42 43 | 113 3 54 | 3.0 | [illegible] | 1.50 | .50 | 1,500 | <.5 | N | N | 50 | 500 | 3.0 | N |
| 339 | DRU7834S | 46 42 48 | 113 0 5 | 3.0 | 1.0 | 1.50 | .30 | 5,000 | N | N | N | 70 | 1,000 | 7.0 | N |
| 340 | DRU7935S | 46 44 31 | 113 5 30 | 5.0 | 1.0 | 1.50 | .50 | 1,500 | N | N | N | 70 | 1,000 | 2.0 | N |
| 341 | DRU7937S | 46 43 24 | 113 5 23 | 3.0 | .7 | 2.00 | .50 | 700 | N | N | N | 70 | 1,000 | 3.0 | N |
| 342 | DRU7939S | 46 41 4 | 113 5 41 | 3.0 | 1.0 | 1.00 | .50 | 500 | .5 | N | N | 150 | 1,000 | 1.5 | N |
| 343 | DRU7941S | 46 40 51 | 113 5 34 | 2.0 | 2.0 | 7.00 | .30 | 1,000 | <.5 | N | N | 100 | 700 | 2.0 | N |
| 344 | DRU7943S | 46 40 25 | 113 5 41 | 5.0 | 2.0 | 2.00 | .50 | 1,000 | N | N | N | 100 | 1,000 | 1.5 | N |
| 345 | ELV1019S | 46 49 48 | 113 18 23 | 3.0 | 5.0 | 15.00 | .15 | 500 | N | N | N | 70 | 200 | 1.5 | N |
| 346 | ELV1025S | 46 49 44 | 115 18 32 | 2.0 | 5.0 | 15.00 | .15 | 500 | N | N | N | 100 | 200 | 1.5 | N |
| 347 | ELV4859S | 46 52 22 | 113 22 23 | 10.0 | 1.5 | 3.00 | .50 | 1,500 | N | N | N | 30 | 700 | 2.0 | N |
| 348 | ELV5830S | 46 46 53 | 113 20 32 | 1.0 | 5.0 | 10.00 | .10 | 300 | N | N | N | 70 | 150 | 1.0 | N |
| 349 | ELV5832S | 46 47 54 | 113 19 13 | 3.0 | .3 | 3.00 | .30 | 500 | N | N | N | 100 | 300 | 1.0 | N |
| 350 | ELV5835S | 46 48 1 | 113 20 35 | 2.0 | .5 | 1.50 | .30 | 300 | N | N | N | 30 | 300 | <1.0 | N |
| 351 | ELV5841S | 46 49 11 | 113 21 49 | 1.5 | 1.5 | 7.00 | .10 | 500 | N | N | N | 50 | 200 | <1.0 | N |
| 352 | ELV5844S | 46 49 14 | 113 21 41 | 10.0 | 2.0 | 5.00 | .15 | 300 | N | N | N | 30 | 100 | <1.0 | N |
| 353 | ELV5846S | 46 50 10 | 113 18 50 | 7.0 | 1.5 | 2.00 | .20 | 500 | N | N | N | 20 | 200 | <1.0 | N |
| 354 | ELV5848S | 46 51 45 | 113 21 14 | 15.0 | .7 | 1.50 | .20 | 500 | N | N | N | 10 | 150 | <1.0 | N |
| 355 | ELV5850S | 46 51 38 | 113 20 38 | 20.0 | [illegible] | 1.00 | .20 | 500 | N | N | N | N | 150 | N | N |
| 356 | ELV5852S | 46 50 44 | 113 20 34 | 5.0 | .7 | 1.50 | .30 | 300 | N | N | N | 15 | 200 | <1.0 | N |
| 357 | ELV5854S | 46 50 9 | 113 17 30 | 2.0 | 1.0 | 2.00 | .30 | 700 | N | N | N | 20 | 300 | 1.5 | N |
| 358 | ELV5856S | 46 47 48 | 113 15 35 | .7 | [illegible] | 1.50 | .20 | 300 | N | N | N | 30 | 200 | 1.0 | N |
| 359 | ELV5857S | 46 46 2 | 113 17 15 | .7 | 2.0 | 7.00 | .15 | 200 | N | N | N | 30 | 200 | <1.0 | N |
| 360 | ELV5859S | 46 45 6 | 113 19 41 | 1.5 | [illegible] | 1.00 | .30 | 700 | N | N | N | 50 | 300 | 1.5 | N |
| 361 | ELV5972S | 46 47 52 | 113 16 2 | 1.5 | 2.0 | 5.00 | .15 | 300 | N | N | N | 100 | 150 | <1.0 | N |
| 362 | ELV5973S | 46 48 3 | 113 16 12 | 3.0 | 1.5 | 3.00 | .50 | 500 | N | N | N | 30 | 500 | <1.0 | N |
| 363 | ELV5977S | 46 46 58 | 113 20 54 | 1.5 | .7 | 1.50 | .20 | 300 | N | N | N | 30 | 500 | 1.0 | N |
| 364 | ELV5979S | 46 47 42 | 113 19 4 | .7 | 2.0 | 5.00 | .10 | 200 | N | N | N | 50 | 100 | <1.0 | N |
| 365 | ELV5980S | 46 47 41 | 113 18 21 | 2.0 | .3 | .50 | .30 | 500 | N | N | N | 100 | 300 | 1.0 | N |
| 366 | ELV5985S | 46 48 29 | 113 21 17 | 1.5 | .7 | 1.50 | .20 | 200 | N | N | N | 20 | 500 | 1.0 | N |
| 367 | ELV5986S | 46 48 32 | 113 21 4 | 1.5 | 1.0 | 7.00 | .10 | 500 | 1.0 | N | N | 50 | 300 | <1.0 | N |
| 368 | ELV5989S | 46 49 14 | 113 17 19 | 3.0 | 2.0 | 10.00 | .15 | 300 | N | N | N | 15 | 200 | <1.0 | N |
| 369 | ELV5991S | 46 51 1 | 113 19 15 | 3.0 | 1.0 | 1.50 | .20 | 500 | N | N | N | 30 | 200 | 1.0 | N |

| | SAMPLE | S-CD | S-CO | S-CR | S-CU | S-LA | S-MO | S-NB | S-NI | S-PB | S-SB | S-SC | S-SN | S-SR | S-V | S-W | S-Y | S-ZN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 325 | DRU3435S | N | <5 | 50 | 20 | 20 | N | N | 10 | 30 | N | 5 | N | 200 | 50 | N | 20 | N |
| 326 | DRU3437S | N | 7 | 100 | 20 | 30 | N | N | 30 | 30 | N | 7 | N | 150 | 70 | N | 20 | N |
| 327 | DRU3438S | N | 10 | 100 | 30 | 50 | N | <20 | 50 | 50 | N | 10 | N | 200 | 70 | N | 20 | N |
| 328 | DRU3440S | N | 10 | 70 | 30 | 30 | N | N | 30 | 30 | N | 10 | N | 300 | 70 | N | 30 | N |
| 329 | DRU3442S | N | 10 | 100 | 30 | 50 | N | N | 30 | 30 | N | 10 | N | 300 | 100 | N | 30 | N |
| 330 | DRU3443S | N | 10 | 70 | 50 | 30 | N | N | 30 | 20 | N | 10 | N | 200 | 150 | N | 30 | N |
| 331 | DRU3445S | N | 15 | 150 | 50 | 30 | N | <20 | 70 | 20 | N | 15 | N | 200 | 200 | N | 30 | N |
| 332 | DRU3448S | N | 5 | 70 | 15 | 30 | N | N | 15 | 30 | N | 5 | N | 300 | 50 | N | 20 | N |
| 333 | DRU3450S | N | 10 | 70 | 20 | 30 | N | N | 30 | 30 | N | 7 | N | 200 | 100 | N | 20 | N |
| 334 | DRU3451S | N | 10 | 100 | 50 | 20 | N | N | 50 | 30 | N | 10 | N | 200 | 200 | N | 20 | N |
| 335 | DRU7824S | N | 10 | 30 | 30 | 50 | N | N | 30 | 20 | N | 7 | N | 100 | 100 | N | 30 | N |
| 336 | DRU7826S | N | 10 | 100 | 20 | 500 | N | <20 | 70 | 30 | N | 10 | N | 700 | 100 | N | 30 | N |
| 337 | DRU7828S | N | 10 | 50 | 30 | 50 | N | <20 | 30 | 30 | N | 7 | N | 700 | 70 | N | 20 | N |
| 338 | DRU7830S | N | 10 | 50 | 30 | 30 | N | <20 | 30 | 30 | N | 7 | N | 200 | 70 | N | 20 | N |
| 339 | DRU7834S | N | 10 | 70 | 30 | 30 | N | <20 | 50 | 30 | N | 10 | N | 300 | 70 | N | 30 | N |
| 340 | DRU7935S | N | 10 | 30 | 30 | 50 | N | <20 | 20 | 30 | N | 10 | N | 300 | 100 | N | 30 | N |
| 341 | DRU7937S | N | 10 | 50 | 50 | 30 | 5 | <20 | 20 | 50 | N | 10 | 15 | 300 | 100 | N | 30 | N |
| 342 | DRU7939S | N | 10 | 70 | 70 | 30 | N | <20 | 30 | 30 | N | 7 | N | 100 | 150 | N | 20 | N |
| 343 | DRU7941S | N | 7 | 70 | 50 | 50 | N | N | 20 | 50 | N | 7 | N | 200 | 100 | N | 20 | N |
| 344 | DRU7943S | N | 10 | 100 | 50 | 50 | N | <20 | 50 | 20 | N | 10 | N | 200 | 150 | N | 30 | N |
| 345 | ELV1019S | N | 7 | 50 | 20 | 30 | N | <20 | 20 | 70 | N | 7 | N | <100 | 50 | N | 15 | N |
| 346 | ELV1025S | N | 7 | 50 | 15 | 30 | N | <20 | 20 | 30 | N | 7 | N | <100 | 30 | N | 20 | N |
| 347 | ELV4859S | N | 30 | 200 | 20 | <20 | 5 | <20 | 30 | 20 | N | 20 | N | 300 | 200 | N | 70 | N |
| 348 | ELV5830S | N | 5 | 20 | 10 | 20 | N | N | 10 | 30 | N | 5 | N | 150 | 20 | N | 10 | N |
| 349 | ELV5832S | N | 10 | 70 | 20 | 30 | N | <20 | 30 | 70 | N | 7 | N | <100 | 50 | N | 20 | N |
| 350 | ELV5835S | N | 7 | 20 | 20 | 20 | N | N | 20 | 30 | N | 7 | N | 200 | 50 | N | 15 | N |
| 351 | ELV5841S | N | 5 | 50 | 10 | 20 | 5 | N | 10 | 30 | N | 5 | N | 200 | 50 | N | 20 | N |
| 352 | ELV5844S | N | 10 | 150 | 15 | N | N | N | 15 | 30 | N | 5 | N | <100 | 200 | N | 15 | N |
| 353 | ELV5846S | N | 10 | 100 | 20 | 20 | N | N | 15 | 30 | N | 7 | N | 200 | 150 | N | 30 | N |
| 354 | ELV5848S | N | 10 | 150 | 15 | 20 | N | N | 10 | 30 | N | 7 | N | 200 | 300 | N | 30 | N |
| 355 | ELV5850S | N | 15 | 200 | 20 | <20 | N | N | 15 | 20 | N | 5 | N | 200 | 500 | N | 30 | N |
| 356 | ELV5852S | N | 10 | 70 | 15 | 200 | N | N | 7 | 30 | N | 10 | N | 300 | 100 | N | 20 | N |
| 357 | ELV5854S | N | 10 | 15 | 15 | 200 | N | N | 10 | 20 | N | 10 | N | 300 | 70 | N | 20 | N |
| 358 | ELV5856S | N | 5 | 10 | 10 | 20 | N | N | 10 | 30 | N | 5 | N | 100 | 20 | N | 10 | <200 |
| 359 | ELV5857S | N | 5 | 30 | 15 | 20 | N | N | 15 | 30 | N | <5 | N | 200 | 20 | N | 10 | N |
| 360 | ELV5859S | N | 7 | 50 | 15 | 30 | N | N | 15 | 20 | N | 7 | N | 150 | 30 | N | 20 | N |
| 361 | ELV5972S | N | 7 | 30 | 15 | 20 | N | N | 20 | 20 | N | 5 | N | N | 50 | N | 10 | N |
| 362 | ELV5973S | N | 10 | 50 | 70 | 30 | N | N | 30 | 50 | N | 7 | N | 500 | 100 | N | 30 | N |
| 363 | ELV5977S | N | 7 | 50 | 15 | 30 | N | N | 20 | 50 | N | 5 | N | 700 | 50 | N | 15 | N |
| 364 | ELV5979S | N | <5 | 15 | 7 | <20 | N | N | 10 | 30 | N | <5 | N | N | 20 | N | 10 | N |
| 365 | ELV5980S | N | 7 | 50 | 15 | 20 | N | <20 | 20 | 30 | N | 5 | N | 150 | 50 | N | 15 | N |
| 366 | ELV5985S | N | 7 | 50 | 10 | 30 | N | N | 20 | 30 | N | 5 | N | 1,000 | 50 | N | 15 | N |
| 367 | ELV5986S | N | 7 | 20 | 20 | <20 | N | N | 10 | 50 | N | 5 | N | 100 | 50 | N | 15 | N |
| 368 | ELV5989S | N | 7 | 50 | 15 | 20 | N | N | 15 | 30 | N | 5 | N | 150 | 150 | N | 15 | N |
| 369 | ELV5991S | N | 7 | 20 | 15 | 20 | N | N | 10 | 20 | N | 10 | N | 500 | 100 | N | 20 | N |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 326 | DRU3437S | 100 | N | 1.0 | 16.0 | 30.0 | .16 | .50 | <1.0 | N |
| 327 | DRU3438S | 200 | N | <1.0 | 25.0 | 38.0 | .05 | .50 | 1.0 | 1 |
| 328 | DRU3440S | 200 | N | 8.0 | 8.0 | 12.0 | <.05 | .45 | <1.0 | N |
| 329 | DRU3442S | 150 | N | 14.0 | 11.0 | 20.0 | .11 | .55 | 1.0 | N |
| 330 | DRU3443S | 300 | N | 7.0 | 6.0 | 10.0 | <.05 | .40 | <1.0 | N |
| 331 | DRU3445S | 200 | N | 11.0 | 5.0 | 10.0 | .07 | .55 | <1.0 | N |
| 332 | DRU3448S | 150 | N | 2.0 | 7.0 | 17.0 | .06 | .50 | 1.0 | N |
| 333 | DRU3450S | 200 | N | 11.0 | 11.0 | 37.0 | .06 | 1.50 | <1.0 | N |
| 334 | DRU3451S | 200 | N | 7.0 | 4.0 | 9.0 | <.05 | .45 | 1.0 | N |
| 335 | DRU7824S | 500 | N | 16.0 | 22.0 | 40.0 | .14 | .65 | <1.0 | <1 |
| 336 | DRU7826S | 200 | N | 18.0 | 23.0 | 32.0 | .09 | .30 | <1.0 | <1 |
| 337 | DRU7828S | 150 | N | 21.0 | 25.0 | 28.0 | .17 | .40 | <1.0 | <1 |
| 338 | DRU7830S | 150 | N | 34.0 | 24.0 | 55.0 | .11 | .85 | <1.0 | <1 |
| 339 | DRU7834S | 150 | N | 17.0 | 23.0 | 26.0 | .12 | .45 | <1.0 | 1 |
| 340 | DRU7935S | 200 | N | 14.0 | 11.0 | 12.0 | .09 | .35 | <1.0 | <1 |
| 341 | DRU7937S | 200 | N | 27.0 | 15.0 | 24.0 | .12 | .40 | 1.0 | <1 |
| 342 | DRU7939S | 300 | N | 8.0 | 8.0 | 12.0 | .08 | .30 | 1.0 | <1 |
| 343 | DRU7941S | 200 | N | 23.0 | 18.0 | 29.0 | .21 | .50 | 1.0 | <1 |
| 344 | DRU7943S | 300 | N | 15.0 | 8.0 | 8.0 | .11 | .35 | <1.0 | <1 |
| 345 | ELV1019S | 70 | N | 13.0 | 27.0 | 6.0 | N | N | N | N |
| 346 | ELV1025S | 100 | N | 11.0 | 15.0 | 17.0 | .06 | .09 | N | 1 |
| 347 | ELV4859S | 200 | N | 6.0 | 5.0 | 10.0 | .05 | .20 | N | 1 |
| 348 | ELV5830S | 50 | N | 9.0 | 14.0 | 16.0 | .06 | .45 | <1.0 | N |
| 349 | ELV5832S | 200 | N | 18.0 | 117.0 | 33.0 | .10 | .55 | <1.0 | 4 |
| 350 | ELV5835S | 200 | N | 10.0 | 21.0 | 10.0 | .06 | .18 | <1.0 | 2 |
| 351 | ELV5841S | 50 | N | 5.0 | 10.0 | 9.0 | <.05 | .25 | <1.0 | N |
| 352 | ELV5844S | 150 | N | 9.0 | 22.0 | 10.0 | .21 | .15 | 1.0 | N |
| 353 | ELV5846S | 300 | N | 11.0 | 7.0 | 12.0 | .14 | .15 | <1.0 | 2 |
| 354 | ELV5848S | 150 | N | 2.0 | 7.0 | 6.0 | .06 | .05 | <1.0 | 1 |
| 355 | ELV5850S | 300 | N | 2.0 | 5.0 | 6.0 | <.05 | .15 | <1.0 | N |
| 356 | ELV5852S | 100 | N | 2.0 | 3.0 | 5.0 | <.05 | .05 | <1.0 | N |
| 357 | ELV5854S | 100 | N | 2.0 | 3.0 | 5.0 | <.05 | .05 | <1.0 | N |
| 358 | ELV5856S | 150 | N | 13.0 | 34.0 | 76.0 | .12 | .88 | 1.0 | 4 |
| 359 | ELV5857S | 70 | N | 27.0 | 27.0 | 35.0 | .07 | .42 | <1.0 | <1 |
| 360 | ELV5859S | 100 | N | 13.0 | 18.0 | 44.0 | .05 | .65 | <1.0 | 4 |
| 361 | ELV5972S | 50 | N | 7.0 | 8.0 | 6.0 | .05 | .10 | <1.0 | N |
| 362 | ELV5973S | 200 | N | 60.0 | 19.0 | 11.0 | .16 | .20 | 2.0 | 1 |
| 363 | ELV5977S | 100 | N | 19.0 | 21.0 | 17.0 | .08 | .15 | <1.0 | 1 |
| 364 | ELV5979S | 70 | N | 15.0 | 32.0 | 42.0 | .09 | .40 | <1.0 | 6 |
| 365 | ELV5980S | 200 | N | 10.0 | 36.0 | 52.0 | .09 | .73 | <1.0 | 2 |
| 366 | ELV5985S | 70 | N | 3.0 | 5.0 | 4.0 | .05 | .10 | <1.0 | N |
| 367 | ELV5986S | 50 | N | 27.0 | 36.0 | 16.0 | .97 | .20 | 1.0 | 6 |
| 368 | ELV5989S | 70 | N | 35.0 | 14.0 | 12.0 | <.05 | .15 | 1.0 | N |
| 369 | ELV5991S | 100 | N | 8.0 | 5.0 | 8.0 | .07 | .05 | 1.0 | N |

| | SAMPLE | LATITUDE | LONGITUDE | S-FE% | S-MG% | S-CA% | S-TI% | S-MN | S-AG | S-AS | S-AU | S-B | S-BA | S-BE | S-BI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 370 | ELVS993S | 46 51 40 | 113 20 58 | 15.0 | .7 | 1.50 | .20 | 1,000 | N | N | N | N | 200 | <1.0 | N |
| 371 | ELVS995S | 46 51 42 | 113 16 53 | 3.0 | 1.0 | 1.50 | .20 | 700 | N | N | N | 15 | 200 | 1.5 | N |
| 372 | ELVS997S | 46 51 23 | 113 18 6 | 2.0 | 1.0 | 1.50 | .30 | 700 | N | N | N | 10 | 200 | 1.0 | N |
| 373 | ELVS999S | 46 47 14 | 113 16 4 | 1.5 | 1.0 | 3.00 | .30 | 700 | N | N | N | 70 | 300 | 1.0 | N |
| 374 | ELV6970S | 46 45 48 | 113 15 59 | 1.5 | .7 | 2.00 | .20 | 500 | .5 | N | N | 70 | 500 | 1.0 | N |
| 375 | ELV6972S | 46 45 44 | 113 21 46 | 2.0 | .7 | 1.00 | .30 | 700 | N | N | N | 100 | 200 | 1.0 | N |
| 376 | UNI5939S | 46 49 19 | 113 22 30 | 3.0 | 1.5 | 7.00 | .30 | 700 | N | N | N | 70 | 1,000 | 3.0 | N |
| 377 | WIH5827S | 46 46 12 | 113 12 51 | 1.5 | .5 | 1.50 | .30 | 300 | N | N | N | 30 | 500 | 1.5 | N |
| 378 | WIH5860S | 46 47 52 | 113 12 10 | 2.0 | .7 | 1.00 | .30 | 300 | N | N | N | 20 | 700 | <1.0 | N |
| 379 | WIH5862S | 46 49 54 | 113 13 27 | 3.0 | 1.5 | 2.00 | .50 | 500 | N | N | N | 20 | 1,000 | <1.0 | N |
| 380 | WIH5864S | 46 47 29 | 113 8 26 | 2.0 | .7 | 1.00 | .30 | 300 | N | N | N | 10 | 1,000 | 1.5 | N |
| 381 | WIH5970S | 46 46 11 | 113 12 56 | 3.0 | .7 | 1.00 | .30 | 500 | N | N | N | 30 | 1,000 | 1.0 | N |
| 382 | WIH6900S | 46 47 40 | 113 11 55 | 2.0 | .5 | 1.00 | .20 | 500 | N | N | N | 20 | 500 | 1.5 | N |
| 383 | WIH6903S | 46 49 52 | 113 13 37 | 1.5 | 2.0 | 3.00 | .15 | 700 | N | N | N | 50 | 200 | 1.0 | N |
| 384 | WIH6904S | 46 47 9 | 113 9 53 | 3.0 | 1.5 | 2.00 | .30 | 500 | N | N | N | 10 | 1,500 | <1.0 | N |
| 385 | WIH7953S | 46 48 28 | 113 8 3 | 3.0 | 2.0 | 2.00 | .50 | 1,000 | N | N | N | N | 2,000 | 1.5 | N |
| 386 | WIH7955S | 46 49 57 | 113 10 25 | 7.0 | 2.0 | 2.00 | .10 | 1,500 | N | N | N | 10 | 2,000 | 2.0 | N |
| 387 | WIH7957S | 46 49 52 | 113 10 26 | 3.0 | 2.0 | 2.00 | .70 | 1,000 | N | N | N | 50 | 2,000 | 2.0 | N |
| 388 | WIH7959S | 46 49 22 | 113 9 28 | 5.0 | 1.5 | 2.00 | .70 | 2,000 | N | N | N | 10 | 2,000 | 2.0 | N |
| 389 | WIH7961S | 46 49 21 | 113 9 39 | 5.0 | 3.0 | 3.00 | .70 | 1,500 | N | N | N | <10 | 2,000 | 2.0 | N |
| 390 | WIH7963S | 46 48 15 | 113 13 3 | 5.0 | 1.5 | 1.50 | .70 | 3,000 | N | N | N | 100 | 1,500 | 2.0 | N |
| 391 | WIH7965S | 46 48 14 | 113 12 56 | 5.0 | 2.0 | 2.00 | .50 | 1,500 | N | N | N | 50 | 2,000 | 2.0 | N |
| 392 | WIH7967S | 46 48 56 | 113 13 23 | 5.0 | 3.0 | 3.00 | .70 | 1,000 | N | N | N | 30 | 1,500 | 2.0 | N |
| 393 | WIH7969S | 46 46 33 | 113 11 50 | 5.0 | 1.5 | 2.00 | .70 | 1,500 | N | N | N | 20 | 2,000 | 1.5 | N |
| 394 | WIH7971S | 46 45 19 | 113 11 48 | 7.0 | 2.0 | 2.00 | .10 | 1,500 | .5 | N | N | 30 | 2,000 | 1.5 | N |
| 395 | WIH7973S | 46 45 38 | 113 8 39 | 3.0 | 1.0 | 2.00 | .70 | 700 | N | N | N | 50 | 1,500 | 2.0 | N |
| 396 | WIH7975S | 46 46 29 | 113 8 1 | 3.0 | .7 | 2.00 | .70 | 1,500 | N | N | N | 20 | 1,500 | 2.0 | N |
| 397 | WIH7977S | 46 46 27 | 113 8 4 | 5.0 | .7 | 2.00 | .70 | 1,500 | N | N | N | 30 | 1,500 | 1.5 | N |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 370 | ELV5993S | N | 15 | 200 | 20 | N | N | N | 15 | 30 | N | 10 | N | 300 | 500 | N | 50 | N |
| 371 | ELV5995S | N | 7 | 50 | 10 | 20 | N | N | 10 | 30 | N | 10 | N | 300 | 100 | N | 30 | N |
| 372 | ELV5997S | N | 7 | 15 | 10 | 20 | N | N | 10 | 30 | N | 10 | N | 500 | 70 | N | 30 | N |
| 373 | ELV5999S | N | 7 | 50 | 20 | 30 | N | N | 30 | 50 | N | 7 | N | 200 | 30 | N | 15 | N |
| 374 | ELV6970S | N | 7 | 30 | 15 | 20 | N | N | 15 | 50 | N | 7 | N | 150 | 50 | N | 15 | N |
| 375 | ELV6972S | N | 7 | 50 | 20 | 20 | N | N | 30 | 50 | N | 7 | N | N | 50 | N | 15 | N |
| 376 | UNI5939S | N | 10 | 100 | 20 | 50 | N | <20 | 20 | 30 | N | 10 | N | 500 | 100 | N | 30 | N |
| 377 | WIH5827S | N | 7 | 50 | 15 | 30 | N | N | 50 | 30 | N | 5 | N | 500 | 30 | N | 10 | N |
| 378 | WIH5860S | N | 10 | 200 | 20 | 300 | N | N | 50 | 30 | N | 7 | N | 500 | 50 | N | 10 | N |
| 379 | WIH5862S | N | 15 | 300 | 20 | 300 | N | N | 70 | 30 | N | 10 | N | 700 | 70 | N | 10 | N |
| 380 | WIH5864S | N | 7 | 70 | 15 | 30 | N | N | 30 | 20 | N | 7 | N | 500 | 30 | N | 10 | N |
| 381 | WIH5970S | N | 10 | 150 | 20 | 30 | N | N | 50 | 50 | N | 7 | N | 300 | 50 | N | 20 | N |
| 382 | WIH6900S | N | 7 | 70 | 15 | 30 | N | N | 50 | 20 | N | 7 | N | 500 | 50 | N | 15 | N |
| 383 | WIH6903S | N | 7 | 50 | 70 | 30 | N | N | 30 | 70 | N | 5 | N | 200 | 50 | N | 15 | N |
| 384 | WIH6904S | N | 20 | 300 | 20 | 50 | N | N | 100 | 30 | N | 10 | N | 1,000 | 70 | N | 15 | N |
| 385 | WIH7953S | N | 10 | 150 | 30 | 70 | N | <20 | 100 | 30 | N | 10 | N | 700 | 70 | N | 50 | N |
| 356 | WIH7955S | N | 20 | 200 | 50 | 100 | N | <20 | 100 | 50 | N | 15 | N | 1,000 | 100 | N | 20 | N |
| 387 | WIH7957S | N | 10 | 200 | 30 | 50 | N | <20 | 100 | 50 | N | 10 | N | 700 | 100 | N | 30 | N |
| 388 | WIH7959S | N | 15 | 150 | 50 | 50 | N | <20 | 100 | 30 | N | 10 | N | 700 | 100 | N | 20 | N |
| 359 | WIH7961S | N | 15 | 200 | 30 | 70 | N | <20 | 100 | 30 | N | 15 | N | 1,000 | 100 | N | 20 | N |
| 390 | WIH7963S | N | 10 | 100 | 30 | 50 | N | <20 | 70 | 70 | N | 10 | N | 300 | 100 | N | 30 | 300 |
| 391 | WIH7965S | N | 15 | 150 | 100 | 70 | N | <20 | 100 | 50 | N | 10 | N | 700 | 100 | N | 30 | N |
| 392 | WIH7967S | N | 15 | 150 | 70 | 70 | N | <20 | 100 | 30 | N | 10 | N | 700 | 100 | N | 30 | N |
| 393 | WIH7969S | N | 15 | 150 | 30 | 70 | N | 20 | 70 | 50 | N | 10 | N | 1,000 | 100 | N | 20 | N |
| 394 | WIH7971S | N | 20 | 300 | 50 | 70 | N | <20 | 100 | 50 | N | 15 | 30 | 1,000 | 100 | N | 20 | N |
| 395 | WIH7973S | N | 15 | 100 | 50 | 70 | N | <20 | 70 | 50 | N | 10 | N | 700 | 70 | N | 30 | N |
| 396 | WIH7975S | N | 15 | 70 | 30 | 70 | N | <20 | 50 | 50 | N | 10 | N | 700 | 70 | N | 30 | N |
| 397 | WIH7977S | N | 10 | 70 | 50 | 70 | N | <20 | 70 | 30 | N | 10 | N | 700 | 150 | N | 50 | N |

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|---|---|---|---|---|---|---|---|---|---|---|
| 370 | ELV5993S | 300 | N | 2.0 | 3.0 | 7.0 | <.05 | .05 | 1.0 | N |
| 371 | ELV5995S | 200 | N | 1.0 | 2.0 | 4.0 | <.05 | .05 | <1.0 | N |
| 372 | ELV5997S | 100 | N | 4.0 | 3.0 | 11.0 | <.05 | <.05 | 1.0 | N |
| 373 | ELV5999S | 100 | N | 19.0 | 65.0 | 55.0 | .10 | .80 | 1.0 | 6 |
| 374 | ELV6970S | 150 | N | 10.0 | 35.0 | 25.0 | .08 | .50 | 1.0 | 1 |
| 375 | ELV6972S | 100 | N | 22.0 | 52.0 | 103.0 | .11 | .70 | 1.0 | 5 |
| 376 | UNI5939S | 200 | N | 5.0 | 10.0 | 14.0 | <.05 | .17 | 2.0 | N |
| 377 | WIH5827S | 150 | N | 13.0 | 14.0 | 22.0 | .08 | .50 | <1.0 | N |
| 378 | WIH5860S | 70 | N | 8.0 | 9.0 | 37.0 | .09 | .20 | <1.0 | N |
| 379 | WIH5862S | 100 | N | 6.0 | 8.0 | 19.0 | .08 | .10 | <1.0 | N |
| 380 | WIH5864S | 100 | N | 12.0 | 6.0 | 15.0 | .10 | .15 | <1.0 | N |
| 381 | WIH5970S | 100 | N | 7.0 | 27.0 | 19.0 | .05 | .35 | <1.0 | 1 |
| 382 | WIH6900S | 100 | N | 10.0 | 8.0 | 51.0 | .17 | .55 | 1.0 | N |
| 383 | WIH6903S | 100 | N | 59.0 | 54.0 | 28.0 | .28 | .70 | 1.0 | 3 |
| 384 | WIH6904S | 100 | N | 8.0 | 7.0 | 17.0 | .12 | .15 | 1.0 | N |
| 385 | WIH7953S | 700 | N | 7.0 | 5.0 | 12.0 | .10 | <.05 | 1.0 | <1 |
| 386 | WIH7955S | 300 | N | 6.0 | 8.0 | 14.0 | .14 | <.05 | 2.0 | <1 |
| 387 | WIH7957S | 300 | N | 5.0 | 8.0 | 11.0 | .08 | .07 | 1.0 | <1 |
| 388 | WIH7959S | 200 | N | 6.0 | 3.0 | 19.0 | .09 | .13 | 2.0 | <1 |
| 389 | WIH7961S | 200 | N | 9.0 | 8.0 | 18.0 | .16 | <.05 | 1.0 | <1 |
| 390 | WIH7963S | 300 | N | 9.0 | 28.0 | 100.0 | .13 | 1.70 | 1.0 | 1 |
| 391 | WIH7965S | 300 | N | 34.0 | 17.0 | 25.0 | .25 | .25 | 1.0 | <1 |
| 392 | WIH7967S | 300 | N | 19.0 | 13.0 | 21.0 | .23 | .15 | <1.0 | <1 |
| 393 | WIH7969S | 300 | N | 5.0 | 14.0 | 72.0 | .09 | .15 | <1.0 | <1 |
| 394 | WIH7971S | 200 | N | 13.0 | 25.0 | 37.0 | .51 | .20 | <1.0 | <1 |
| 395 | WIH7973S | 300 | N | 12.0 | 7.0 | 10.0 | .16 | .09 | <1.0 | <1 |
| 396 | WIH7975S | 200 | N | 11.0 | 9.0 | 11.0 | .15 | .38 | <1.0 | <1 |
| 397 | WIH7977S | 300 | N | 12.0 | 8.0 | 18.0 | .09 | .39 | <1.0 | <1 |

Form 1279—3
(June 1984)

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Fernette, Greg.
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